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MDC/DWM
Watershed Protection Plan Update
Quabbin Reservoir Watershed and Ware River Watershed

For Metropolitan Boston Water System and Chicopee Valley Aqueduct Communities
December 2000

**

Prepared by
Metropolitan District Commission/Division of Watershed Management

December 2000

Commonwealth of Massachusetts
Argeo Paul Cellucci, Governor

Executive Office of Environmental Affairs (EOEA)
Robert Durand, Secretary

Metropolitan District Commission (MDC)
David B. Balfour, Commissioner

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MDC/DWM WPP Core Working Group

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Acronyms

AMWD	Apparent Molecular Weight Distribution
APA	American Planning Association, the primary professional planners' organization
APR	Agricultural Preservation Restriction, a form of conservation restriction held by DFA
ASCS	Agricultural Stabilization and Control Service, an outreach office of USDA
AST	Above-ground storage tanks
ATV	All-terrain vehicles
AWWA	American Water Works Association, a professional water suppliers' organization
BCB	Boston City Base, a datum reference
BDOC	Biodegradable Organic Carbon
BMP	Best Management Practices, including source and treatment controls on non-point source pollution
BOH	Board of Health, a board of local governments
CCR	Consumer Confidence Report
CDM	Camp Dresser & McKee Inc., an engineering consulting firm
CE	Civil Engineering, a section of the MDC Division of Watershed Management
CEI	Comprehensive Environmental Inc., an environmental consulting firm
CERO	DEP Central Regional Office, located in Worcester
CFI	Continuous Forest Inventory
CFR	Code of Federal Regulations
CFU	Colony forming units
Ch. 61	Chapter 61, part of the Massachusetts law that addresses taxes for forest and agricultural land
CMR	Code of Massachusetts Regulations
CR	Conservation Restriction
CVA	Chicopee Valley Aqueduct
DEM	Massachusetts Department of Environmental Management
DEP	Massachusetts Department of Environmental Protection
DFA	Massachusetts Department of Food and Agriculture
DFW	Massachusetts Division of Fisheries and Wildlife, part of the Massachusetts Department of Fisheries, Wildlife, and Environmental Law Enforcement
DOC	Dissolved Organic Carbon
DPW	Department of Public Works, part of town and city governments

DWM	Division of Watershed Management, the Division of the MDC that is responsible for watersheds
DWS	Division of Water Supply, a Division of DEP
EAP	Emergency Action Plan
EIR	Environmental Impact Report
EOEA	Executive Office of Environmental Affairs
EPO	Environmental Police Office
EP	Environmental Planning, a section of the MDC Division of Watershed Management
EPA	Environmental Protection Agency
EQ	Environmental Quality, a section of the MDC Division of Watershed Management
ERP	Emergency Response Plan
ESA	Environmental Site Assessment
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FTE	Full-time employee
FTN	FTN, an environmental modelling firm
FY	Fiscal Year
GIS	Geographic Information Systems
HHW	Household Hazardous Waste
ICR	Information Collection Rule
ICS	Incident Command System
IFA	Immunofluorescence assay
IPM	Integrated Pest Management
LAPP	Land Aquisition Policy Panel
LSP	Licensed Site Professional
LTBI	List of Sites to be Investigated
MASSGIS	A division of EOEA that manages state GIS data
MCP	Massachusetts Contingency Plan

MDC	Metropolitan District Commission
MDPH	Massachusetts Department of Public Health
MEMA	Massachusetts Environmental Management Agency
MEPA	Massachusetts Environmental Policy Act Unit
MGD	million gallons per day
M.G.L.	Massachusetts General Laws
MHD	Massachusetts Highway Department
MOU	Memorandum of Understanding
MWRA	Massachusetts Water Resources Authority
NALMS	North American Lakes Management Society
NOM	Natural Organic Matter
NPDES	National Pollutant Discharge Elimination System
NR	Natural Resources, a section of the MDC Division of Watershed Management
NRCS	Natural Resources Conservation Service, a federal agency under the USDA
NURP	National Urban Runoff Project, a study of stormwater pollutants
NQRLP	North Quabbin Regional Landscape Partnership
OAG	Office of Attorney General
O&M	Operations and Maintenance
PILOT	Payments in Lieu of Taxes
PCB	Polychlorinated biphenyl, a contaminant
PHC	Petroleum Hydrocarbons
QA/QC	Quality Assurance/Quality Control
QWAC	Quabbin Ware Advisory Committee
RAO	Risk Assessment Office
ROW	Rights of Way
SAGEE	Secretary's Advisory Group on Environmental Education
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SWAP	Source Water Assessment Program

SWTR	Surface Water Treatment Rule
THM	Trihalomethane
TOC	Total Organic Carbon
TRCS	Transportation Release Controls Study
TSS	Total suspended solids
UIC	Underground Injection Control
USDA	U.S. Department of Agriculture
USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey
UST	Underground Storage Tank
VMP	Vegetation Management Plan
WAC	Watershed Advisory Committee
WET	Water Education for Teachers
WPP	Watershed Protection Plan
WREEN	Worcester Regional Environmental Educator's Network
WRPP	Watershed Resource Protection Plan
WSC	DEP Bureau of Waste Site Cleanup
WsPA	Watershed Protection Act
WWTP	Wastewater Treatment Plant
YOP	Yearly Operating Plan

Executive Summary

Purpose of this Update

This document represents an update to the *Watershed Protection Plan for Quabbin Reservoir Watershed and Ware River Watershed*, developed in 1991 by the Metropolitan District Commission Division of Watershed Management (MDC/DWM) and the Massachusetts Water Resources Authority (MWRA). The Update summarizes MDC/DWM's comprehensive watershed protection program, highlights program accomplishments since 1991, presents additional watershed and reservoir data that are now available, and presents an action plan for the next five years. Watershed protection is the first of the fundamental elements of the MWRA Drinking Water Quality Improvement Strategy. Ensuring the best source of water quality is the foundation of this strategy, followed by major distribution system and storage facility improvements, and phased treatment improvements.

MDC - a History of Protecting the Reservoirs

The MDC has been responsible for protecting the Metropolitan Boston water supplies, which are the Quabbin and Wachusett Reservoirs, since their construction. Historically, MDC has managed, operated, and maintained the water supply system, including its dams and transfer mechanisms, bridges, buildings, and other facilities. A map of the MDC/DWM-MWRA Water Supply System is shown in **Figure 1-1**.

In 1984, the former MDC Water Division was divided into the Division of Watershed Management (MDC/DWM) and the Massachusetts Water Resources Authority Waterworks Division. Under the DWM organization, the capabilities for watershed protection and management were expanded. The DWM has received significant financial and legislative support for its watershed protection activities. The DWM staff has increased in terms of numbers and disciplines (professional engineers, foresters, biologists, certified planners, etc.); and the staff compose a professional, trained team dedicated to watershed protection.

History of Watershed Protection

1908:	Wachusett Reservoir constructed and filled. MDC makes initial watershed land acquisitions and begins water quality monitoring and forest management
1946:	Quabbin Reservoir constructed and filled. MDC acquires lands to bring total watershed ownership to 107,000 acres
1984:	Division of Watershed Management (MDC/DWM) created within the Metropolitan District Commission
1980 - 1990s:	DWM expands professional staff and watershed programs.
1991:	MDC/DWM and MWRA develop Watershed Protection Plans (WPPs)1991- present MDC/DWM implements WPPs
1998:	MDC/DWM and MWRA update the WPP for Wachusett Reservoir Watershed
2000:	MDC/DWM and MWRA update the WPP for Quabbin Reservoir Watershed and Ware River Watershed

In 1991, DWM and MWRA prepared the Watershed Protection Plans (referred to as 1991 Plans or WPPs) for Quabbin Reservoir/Ware River Watersheds and for Wachusett Reservoir Watershed. These were the first formal written plans for management of the watersheds. This document, along with the 1998 Update for the Wachusett Reservoir watershed, represents a comprehensive update of the 1991 Plans.

Implementation of the 1991 Plans

Throughout the 1990s, DWM fully implemented the 1991 Plans, expanding its watershed protection program to control pathogens and other contaminants, addressing issues such as increasing recreational pressures for access on water supply lands and waters, wildlife, construction, on-site septic systems, agriculture, spills, and other issues. Comprehensive watershed sanitary surveys were conducted for each basin, forming the foundation for many of DWM's remediation and planning efforts. From a history of forestry and management of its own land holdings, DWM has grown into a steward of the entire watershed system. As a major watershed steward, DWM plays a positive role in controlling the land cover, land uses, and activities of significance for watershed protection.

Characteristics of Reservoirs and Watersheds

The Quabbin Reservoir contributes more than 50% of the Wachusett Reservoir's annual inflow. Quabbin Reservoir's elongated shape and large size result in long detention times, and significant dilution and settling of tributary inflows. This long reservoir has two main longitudinal sections linked by a narrow channel, the Enfield Channel. The Quabbin Reservoir's volume capacity is 412 billion gallons, and its surface area is 39.4 square miles. The Quabbin reservoir's watershed area is 187 square miles. The maximum depth in the reservoir is 151 feet. The mean depth is 45 feet. Water quality of the Quabbin Reservoir is excellent. The reservoir has very crystalline water with low turbidity, bacterial counts, algal densities, and nutrients. The detection of the pathogens *Giardia* and *Cryptosporidium* at the reservoirs' intakes has been very low, with no confirmed *Cryptosporidium* or confirmed *Giardia* samples.

The Ware River and its tributaries also have good water quality. All tributaries exhibit more variation in water quality compared to reservoirs and aqueduct intakes. Generally, reservoirs and lakes often have "cleaner" water quality than their tributaries since the water bodies provide settling. Turbidity levels and fecal coliform bacteria concentrations in the tributaries and in the Ware River fluctuate in response to storm flows and other conditions. Water quality in this watershed is typical for tributaries in sparsely developed areas of New England.

The two typical land cover types in the watersheds of the Quabbin Reservoir and Ware River are forests and wetlands, collectively totaling 87% of the Quabbin Reservoir watershed (excluding the reservoir surface area), and 75% of the Ware River watershed. The largest remaining land use classes are residential use and agricultural use. Residential land use is generally low density. Commercial and other land uses are less significant in the watersheds. Although the watershed system is sparsely developed, the level of developed land is lowest in the Quabbin Reservoir watershed, and becomes more developed and populated eastward to the Ware River watershed. **Figure 2-2** shows the land use classifications throughout the Quabbin Reservoir watershed and Ware River watershed.

The Role of the Plan Update

In the years since the 1991 Plan, DWM has progressively increased its knowledge of the Quabbin Reservoir, Ware River, and their watersheds. During this time, concern over and understanding of health risks from water supplies has also increased within the water supply industry. Over the past decade, DWM completed many studies, increasing the available body of watershed and reservoir data. DWM and MWRA completed a hydrodynamic study for the Quabbin Reservoir. DWM has also conducted expanded water quality monitoring including pathogens, and has conducted studies of other indicator organisms in both the Quabbin Reservoir watershed and Ware river watershed. In addition, MDC/DWM has conducted biomonitoring, initiated various pilot projects such as stormwater Best Management Practices (BMPs), funded an agriculture inventory, developed a geographic information system (GIS) coverage at a parcel level of detail for all three watersheds, completed in-house wildlife surveys, and conducted watershed sanitary surveys.

The Plan Update uses this knowledge to provide a framework for prioritizing and implementing the complement of watershed protection activities through the definition of water quality goals (see box), articulated watershed protection goals, and defined geographical protection zones. The Plan Update meets the Federal and State requirement of minimizing the potential for contamination by *Giardia* cysts and *Cryptosporidium* oocysts in the source water.

DWM has defined zones for its watershed protection practices in all three watersheds. MDC/DWM has historically used four Sanitary Districts in each watershed. Each District is comprised of tributary sub-basins (**Figure 2-1A & B**). MDC/DWM also has intake protection zones around the Ware River intake and Chicopee Valley Aqueduct in which unauthorized access is prohibited.

Water Quality Goals

Primary Goals:

- To prevent waterborne disease
- To meet the source water coliform criterion
- To maintain a high quality source water

Secondary Goals:

- To reduce/control nutrient inputs to the reservoirs
- To reduce the risk of a chemical or hazardous material spill
- To control general pollutant transport into the reservoir

Assessment and Prioritization of Potential Water Contamination Threats

The 1991 Plan included an evaluation and ranking of water quality contamination sources. This Plan Update presents an assessment and threats ranking based , in general, on MA DEP's Source Water Assessment Program (SWAP) guidance. This Plan's threats rankings are based, in particular, on DWM's experience, studies concerning contamination sources completed in the last five years, and defined water quality goals.

The MDC/DWM's ranking, summarized in **Table ES-1**, shows some changes reflecting the shift of the water supply industry, and Federal and State drinking water regulations towards concern for waterborne microbial contaminants that can cause acute illness. While MDC/DWM and MWRA remain committed to reducing all potential contaminants into the reservoir and its watersheds, it is clear from drinking water industry research that control of microbial pathogens must be a top concern. Therefore, those activities involving potential exposure of human or animal wastes are high priority for control. Conversely, other types of pollution threats, such as underground fuel storage tanks are highly regulated by Massachusetts Department of Environmental Protection (DEP) and typically pose a low-level risk to large surface water sources.

Table ES-1
MDC/DWM's Updated Priority Ranking of Potential Water Quality Impairment Sources
January 2000

Potential Source of Contamination	*MDC/DWM Quabbin Section Priority 2000*
Wildlife - Birds	High
Wildlife - Aquatic Mammals	High
On-Site Septic Systems	Moderate
Agriculture	Moderate
Highways and Railways	Moderate
Stormwater Runoff	Moderate
Recreation/Public Access on Water supply Lands and Waters	Moderate
Local Land Uses/Activities	Moderate
Private Forestry (under approved Forest Cutting Plan)	Low
Unauthorized Activities	Moderate
State Regulated Sites/Activities	Low
Habitat Modification (erosion)	Low

Source: (MDC/DWM, 2000)

Effectiveness of MDC/DWM Watershed Protection Program

MDC/DWM and MWRA are committed to a strong watershed protection program for the MDC/DWM Quabbin Reservoir/Ware River/ Wachusett Reservoir watersheds (regardless of what treatment system is used). DWM has adopted a three-tiered approach to watershed protection:

1. Protect the most sensitive watershed areas through land ownership or agreements with landowners;
2. Work with watershed communities to protect resources while accommodating community needs, and
3. Correct existing sources that could cause or have caused contamination of any waters in the system.

Direct Control through Land Ownership – Protected Lands

Direct ownership of critical land in the watersheds ensures maximum control over land cover and land use, and provides the best protection of water quality.

DWM has in place an aggressive land acquisition program to add to its existing protected acreage. MDC/DWM's GIS-based land acquisition model was developed to determine and prioritize which remaining undeveloped parcels in the watersheds might offer the greatest protection to water quality. Annual land acquisition priorities are based, in part, on the results of this model. Since 1991, 14,637 acres of land have been added to MDC/DWM holdings to increase protection. The percentage of MDC/DWM-owned land in the Wachusett Reservoir watershed has increased from 7.9% in 1985, to 25.5% in 1998, or 29.6% if the reservoir's surface area is included. MDC/DWM currently owns 42% of the total land area of the three active watersheds: Quabbin Reservoir, Ware River, and Wachusett Reservoir. These MDC/DWM owned lands include all the high-risk lands which are directly surrounding the reservoirs. **Figure 2-3** shows the distribution of MDC/DWM holdings as of January 2000.

In addition to the land held by MDC/DWM, over 17,000 acres in the Quabbin Reservoir watershed and over 13,000 acres in the Ware River watershed are protected from development by many other organizations and government agencies which own and maintain land as open space (**Table 4-2**). This includes other state agencies, notably the Massachusetts Department of Fisheries and Wildlife (MDFW), town conservation land including other water suppliers, privately owned lands in Chapter 61, 61A, and 61B status, and parcels held by land trusts and conservation groups.

Table ES-2 summarizes the MDC/DWM-owned and other protected lands in the watersheds. The sum of MDC/DWM-owned and other protected lands totals over 75% of the Quabbin Reservoir watershed lands, excluding reservoir surface area, and about 57% of the Ware River watershed.

Table ES-2

MDC/DWM Owned and Other Protected Lands

Watershed	*MDC/DWM-Owned as a % of the Watershed**	*Other Protected Lands as a % of the Watershed***	*Total Protected Lands as a % of the Watershed****
Quabbin Reservoir	57%	18%	75%
Ware River	37%	20%	57%
Wachusett Reservoir	26%	26%	52%

Source: (MDC/DWM - GIS, 2000)

* % of watershed area excluding reservoir surface.

** Includes lands owned by other State agencies, local government, and private entities.

*** Approximately 11.5% of public and private lands in the Quabbin Reservoir watershed is regulated by the Watershed Protection Act. In the Ware River watershed, approximately 17.5% of the watershed's private and public lands are regulated by the Act. In the Wachusett Reservoir watershed, approximately 17% of the watershed is regulated by the Act. These WsPA percentages exclude MDC/DWM owned lands including the reservoir surface areas.

In the next five years, DWM objectives are to continue acquiring lands with the $8 million available per year in Watershed Protection Act funds, applying FY2001 to purchases among the three watersheds. DWM will maintain, and improve, the methods and processes it has developed for the identification and prioritization of parcels, as well as for surveys, legal aspects, and transfers of the parcels.

Currently, the *MDC/DWM Quabbin Reservoir Watershed Land Management Plan – 1995-2004* is in full implementation on MDC/DWM owned lands. DWM has begun to prepare a 10-year Land Management Plan addressing all MDC/DWM-owned lands in the Ware River watershed, including forest and non-forest components. The Land Management Plan will document the foresters' inventory of forest composition and condition on MDC/DWM lands, and detail the schedule for needed management actions (such as regeneration, cutting, reforestation, and fire access roads) to establish and maintain a diverse, multi-layered forest which will promote long-term water quality protection. MDC/DWM's Land Management Plan will address vegetation management policies and practices on non-forested land, such as fields. The plan will spell out mowing frequency and grass height for various areas, a policy for reforestation of newly acquired parcels, and monitoring of conservation restrictions.

DWM will continue the Watershed Ranger program to patrol, educate, and enforce its policies in the watersheds and near the reservoir. Watershed Rangers will continue to implement the *Quabbin Reservoir Watershed Public Access Management Plan Update* (MDC/DWM, 1998) and MDC/DWM's *Public Access Management Plan Update for the Ware River Watershed* (MDC/DWM, 2000). MDC/DWM's Watershed Rangers will improve the tools for public access control, including installing additional easy-to-understand signs throughout the watershed and developing brochures.

DWM will continue and expand its contact with other owners of protected open space, including maintaining an up-to-date inventory of such lands and their management practices. DWM will continue to provide assistance to keep Chapter 61 lands in that protected status and work with owners of forested tracts of land to develop professional forest management plans.

Regulatory Control Through MDC's Watershed Protection Regulations and Public Education

The Quabbin Reservoir watershed and Ware River watershed have been protected for many years by general prohibitions on the taking or degradation of the waters of the watershed. In 1992, a more specific set of protections was passed by the Massachusetts legislature.

The Watershed Protection Act (WsPA) was passed in 1992, providing unique protection to the watersheds of the Quabbin Reservoir, Ware River, and Wachusett Reservoir (M.G.L. Chapter 36 of the Acts of 1992). The WsPA has been fully implemented since early 1995. The Act and its regulations (350 CMR 11.00) regulate land uses and activities in two critical areas, shown in **Figure 5-1**. Within 400 horizontal feet of the reservoirs and 200 horizontal feet of tributaries and surface waters (the Primary Protection Zone), any alteration is prohibited. Note that MDC/DWM owns nearly 100% of the lands within 400 horizontal feet of the reservoir, and much of the tributary buffers as well. Between 200 and 400 horizontal feet of tributaries and surface waters and on certain other lands (the Secondary Protection Zone), specific activities are prohibited, and all development is scrutinized. Through the Act, MDC/DWM regulates 11,011 acres in the Quabbin Reservoir watershed and 10,824 acres in the Ware River watershed.

DWM staff work to administer the WsPA and its regulations, ensuring a protection buffer area between future development and waters of the watershed and prohibiting land uses of concern within the protective zones. From 1997 to 1999, DWM received and acted on 243 WsPA applications in the Quabbin Reservoir watershed and Ware River watershed. Approximately one-half of the applications are for accessory uses, additions, or redevelopment; one-quarter of applications are for new construction; and approximately one-fifth are requests for opinions on how a property is affected, with no activity proposed.

DWM has found the WsPA to be a strong tool to manage development and prevent improper activities in the most sensitive lands buffering water resources, i.e., the Primary and Secondary Protection Zones. In the next five years, DWM's primary objective pursuant to the WsPA, is to continue to implement, enforce, and uphold all provisions of the WsPA and its regulations.

Maximize Protection Provided by Body of State/Local Regulations

MDC/DWM and MWRA have developed a watershed protection strategy which supplements the direct ownership of the most sensitive lands by working with State agencies, communities, and individual landowners to ensure that the strong protection afforded by State and local environmental regulation is fully utilized. With this philosophy, MDC/DWM is at the forefront of a new approach to watershed management: forming true partnerships with watershed communities and using incentives and technical assistance to accomplish effective water quality protection.

Enforcement of State Regulations

State laws and regulations apply throughout the Quabbin Reservoir watershed and Ware River watershed. They serve as a significant control of potentially polluting activities on private lands. Selected Massachusetts environmental regulations are listed in **Table ES-3** below:

Table ES-3
Selected Massachusetts Laws, Regulations, and Policies Providing Watershed Protection

Act-Regulation-Policy	*Activity - Relevance*
Title 5	Regulates the siting, design, and inspection of on-site systems; provides a means for attaining adequate function from existing systems (via inspection at property transfer).
MEPA	Requires comprehensive environmental assessments and public review of major projects.
Wetlands Protection Act	Restricts the alteration and/or filling or wetlands; requires review of all projects within 100 feet of wetlands or within floodplains.
Rivers Protection Act	Establishes buffer zones around rivers and streams; within these buffers, development criteria apply.
Stormwater Policy	Address stormwater from development projects under the existing WPA Notice of Intent process.
Forest Cutting Practices Act Regulations	Requires filing of a cutting plan; mandates unaltered buffer strips; provides operational standards including stream crossings.

In addition to the Acts, regulations, and policies listed above, state agencies regulate activities and facilities that have potential to introduce contaminants to the environment through other measures, such as Pesticide Regulations, Solid Waste Regulations and Massachusetts Contingency Plan (hazardous materials spill sites). MDC/DWM and DEP work together closely; in 1999 a protocol between MDC/DWM and DEP-CERO was signed to formalize the procedures that cooperatively ensure compliance with these environmental regulations. DWM is on site in the watershed, and can act as the "eyes and ears" for DEP to provide field visits to properties and facilities, guidance to landowners on how to comply with the regulations, and enforcement documentation to DEP.

Over the next five years, DWM aims to implement the enforcement protocol with MA DEP, to assist other agencies in fact gathering, to exchange information, and to expedite enforcement where needed.

Watershed Community Technical Assistance

DWM's ongoing program of watershed community technical assistance and outreach program to watershed town boards, who oversee many land use regulations, includes many elements:

- Review, revision, and/or development of by-laws, subdivision and other regulations;
- Presentation of workshops on planning topics to local boards and the public;
- Attendance at Board of Health and Conservation Commission meetings for the watershed towns and attendance at meetings of other boards (e.g., Selectmen, Planning Board upon request or when there is an agenda item important to DWM; and
- Development of a grant program to sponsor projects such as growth management planning and land use studies.

Over $150,000 in direct funding and many hours of DWM staff time have been committed to technical assistance. These resources have affected every town in the watersheds of the Quabbin Reservoir and Ware River. Over the next five years, DWM will continue to provide direct technical assistance and comment on proposed developments at town board meetings, and will continue to develop and provide training workshops. Also, DWM will continue administering existing planning grants as well as developing and implementing a formal grants program to maximize watershed benefits from these funds.

Public Education

DWM conducts various educational and outreach efforts aimed at the watersheds schools, watershed residents, visitors, and the general public. DWM's Director is the state coordinator of Water Education for Teachers, or Project WET, a program to train teachers in environmental curricula. DWM's Interpretative Services staff conduct education programs in local schools, and interpretive programs for adults in the field. From 1996 to the present, 600 educational/interpretive programs have been held in the watersheds, with an estimated 33,000 participants.

In the next five years, DWM will continue its array of educational programs, increase the interpretive and on-site educational programs, and develop informational materials.

Controlling Potential Pathogen Sources – Pathogen Prevention Programs

MDC/DWM's top water quality goal for the metropolitan Boston water supply system is to minimize the risk of waterborne disease from pathogens. DWM has prioritized the control of land uses and conditions that may represent pathogen sources. Generally, potential sources of waterborne disease include human waste (e.g., sewage discharges, recreation), and animal populations (e.g., wildlife, farm animals, and domestic animals). DWM is actively participating in controlling these sources by minimizing potential for deposition of wastes in the watersheds, and then minimizing their transmission to the reservoir.

DWM has successfully developed the Bird Harassment Program, now viewed as a model for other water supply managers. Prior to 1992, roosting gulls were causing elevated fecal coliform concentration levels in water samples taken from the reservoir. DWM's program has dramatically reduced the fecal coliform bacteria counts at the Chicopee Valley Aqueduct (CVA) intake. MDC/DWM's Bird Harassment Program uses a variety of noise makers, distress calls, and visual objects to disturb birds landing or roosting on the reservoir. The harassment focuses on the defined MDC/DWM's Bird Control Zone, covering the area of the reservoir from the CVA intake to the Boat Mooring (Fishing Area #1/MDC/DWM Gate 8; see **Figure 6-1**). In addition to harassment, DWM biologists have successfully reduced the attractiveness of certain areas as habitat for birds, food sources, and nesting populations of geese and gulls.

DWM has defined an Aquatic Wildlife Pathogen Control Zone (see **Figure 6-2**), in which DWM conducts surveys for and removes animals of concern (e.g., beaver and muskrat). DWM is also modifying habitat to reduce attraction of the species to the area.

Within the next five years, DWM will continue to control the occurrence of gulls, geese, and other waterfowl in the Bird Control Zone through a combination of harassment, nest disturbance, and removal; and will expand its use of habitat modification methods. DWM will survey for and remove muskrat and beaver within the Aquatic Wildlife Pathogen Control Zone. Also, DWM biologists and engineers will continue to study the prevalence of pathogens in wild species, develop and use methods to identify pathogens as either human or non-human, and continually reassess the risk posed by wildlife sources and methods to control them.

Agriculture

DWM recently completed a review of agricultural sites in the watersheds and identified potential BMPs that could be implemented. DWM staff will address site-specific problems with smaller farms through the watershed sanitary survey process. In the next five years, DWM aims to implement agricultural BMPs at the high priority sites in the watershed, in cooperation with the Massachusetts Department of Food and Agriculture (DFA), the federal NRCS, DEP, and landowners. DWM's role will include participation on an Agricultural Advisory Group. DWM will also develop and implement an approach to assess and remediate, if needed, water quality issues from small-sized animal operations (e.g., backyard horse paddocks).

Wastewater Disposal

The watersheds have no point sources of wastewater, such as industrial or wastewater treatment plants, but areas of on-site septic systems were identified in the 1991 Plans as concerns that could impact water quality. MDC/DWM quickly focused resources on these areas, and has begun to implement remediation measures. In addition, DWM has several on-going projects to aid Boards of Health and DEP in addressing the remaining localized problems with on-site systems. These projects include beginning development of an on-site septic system database. DWM plans on continuing to develop more information concerning the condition of on-site systems and approaches to remediation, expand public education, and evaluate the agency's role in long-term management of on-site systems.

Stormwater

Stormwater is not a contamination source itself, but is a conduit for pollutant and sediment transport to tributaries and reservoirs. DWM recognizes stormwater management as an opportunity to use physical barriers and processes to provide pre-treatment of watershed flows prior to water entering the main body of the reservoir, supplementing the previously described source controls. DWM is completing the Wachusett Reservoir Stormwater Management Study, including modeling of subbasin stormwater loads and evaluation of stormwater BMPs. DWM has installed or implemented several BMPs to control stormwater throughout the watersheds. DWM is assessing the possibility of using wetland treatment cells for highway stormwater discharges.

The DWM's primary objective for the stormwater program in the next five years is to prepare an annual watershed based Stormwater Project List, bringing all the elements together in the context of monitoring and modeling results, and prioritizing the projects with an implementation schedule. The List will include stormwater BMPs on MDC/DWM property and priority BMPs organized by subbasin. Additional elements of DWM's approach to stormwater include encouraging town-wide stormwater management plans and conducting future studies and mapping initiatives necessary to support stormwater controls.

Visitor Sanitation

Since 1991, DWM has increased its capacity to manage visitor sanitation issues within its water supply lands open to the public, by installing approximately 22 portable sanitary toilets in high use areas. In the next five years, DWM staff will monitor and adjust its visitor sanitation program according to shifting visitor patterns and toilet functionality. In addition, DWM staff will continue its public education and outreach activities on visitor sanitation.

Watershed Protection Controls for Site-Specific Threats

Since 1991, DWM has enhanced its watershed controls over five categories of site-specific water quality threats.

Highways, Railways, and Utility Rights-of-Way

DWM's Transportation Release and Control Study surveyed the risks of stormwater runoff and accidental spills from roads and railways. MDC/DWM monitored the development of Vegetative Management Plans (VMPs) for rights-of way and monitored the resulting implementation of the rights-of-way Yearly Operational Plans (YOP). In the next five years, DWM will increase its involvement with YOP development, and will closely monitor activities in rights-of-ways.

Landfills and Underground Storage Tanks: Construction/Suspected Sites

DWM monitored closed landfills, investigated all known Underground Storage tanks, monitored construction and investigated other suspected sites in the watersheds through the sanitary survey process and the implementation of the WsPA. DWM will continue site inspections to monitor underground storage tanks, tank pulling, and closed landfills.

Emergency Planning and Response

MDC/DWM considers emergency planning and response to be a tool to minimize the threat of accidental spills, particularly in the watersheds' transportation corridors. DWM's Hazardous Materials Emergency Response (HMER) Study developed recommendations for the watershed communities' Emergency Response Plans. In the next five years, DWM plans to implement the HMER study's recommendations and foster increased training and equipping of local responders in the watershed communities.

Building and Road Construction

DWM increased its ability to control development impacts through the passage of the Watershed Protection Act (WsPA) and the consolidation of MDC's Watershed Protection regulations (350 CMR 11.00). In the next five years, DWM will continue to implement its regulations and foster interagency partnerships (e.g., MDC/DWM and MassHighway Department), as well as continue to monitor construction sites in the watersheds.

Infrastructure Inspection and Maintenance

MDC/DWM conducts systematic inspections and maintenance activities throughout its infrastructure (e.g., Winsor Spillway, the Goodnough Dike, MDC/DWM bridges and dams). In the next five years, DWM will monitor, inspect, maintain, repair, and improve its infrastructure as necessary for watershed protection.

MDC/DWM's Monitoring Programs

Water Quality

MDC- DWM conducts extensive routine water quality monitoring in the reservoirs and watershed locations, and collects non-routine samples to support research and enforcement actions. Data collected include physical parameters, chemical parameters such as nutrients, and microbiological parameters. MWRA's Deer Island laboratory provides low-level nutrient analyses for DWM watershed samples. These methods have not been readily available through commercial laboratories, and are essential for long-term understanding of nutrients in the system.

DWM Monitoring and Research

- Routine watershed stations and reservoir sites
- Pathogen monitoring
- Algae
- UMass study evaluating methods to differentiate the origin (e.g., human or animal) of microorganism
- Nutrient-algae studies

DWM also monitors for pathogens and algae. Several years ago, DWM began to supplement water quality monitoring with biomonitoring to better understand water quality of tributaries. These results show that the tributaries' biota are indicative of good water quality.

DWM has also initiated research that may prove to be very important to the understanding of the watershed and water system. DWM funded the University of Massachusetts to test the application of various analytical methods and parameters to differentiate between contamination from humans and contamination from animals. Initial reports have been promising. The work is focused on three tests: *Bifidobacteria*, *Rhodococcus coprophilus*, and *F specific RNA coliphage*.

Flows

Streamflow gages, stormwater flows, reservoir hydrodynamics, and watershed hydrology are part of DWM's flow monitoring program. An up-to-date understanding of reservoir hydrodynamics and watershed hydrology is important to the overall effectiveness of MDC/DWM's watershed protection program. In the next five years DWM seeks to further its understanding of streamflow gages, stormwater flows, reservoir hydrodynamics, and watershed hydrology.

Watershed Sanitary Surveys

DWM has been conducting sanitary surveys in the watershed since 1988. In 1997, DWM refined its survey approach to conduct a very comprehensive survey at the subbasin level. DWM developed an expanded method, pulling in data from field surveys, other DWM staff, other agencies, and town records. The watershed surveys are important to understand the significance of potential sources of contamination and to set priorities among and within the various watershed protection programs.

In the next five years, DWM will continue its routine monitoring which will be planned annually and includes: pathogen monitoring; algae monitoring; and special studies. DWM's special studies include any additional water quality sampling needed to investigate and/or document water quality issues throughout the watershed, such as a long-term study of the impact of sewering on tributary fecal coliform, and studies of stormwater quality from different land uses. DWM will conduct its expanded watershed sanitary surveys on a rotating schedule so that there is a complete investigation of every sub-basin every five years.

Action Plan

The MDC/DWM's Action Plan for the Quabbin Reservoir watershed and Ware River watershed, summarized following this page, lists DWM's anticipated watershed management activities for the next five years. These activities are presented in more detail in Sections 4 through 8 of this report). The Action Plan also shows key sections responsible for the general activities. During the five-year period covered by this plan update, DWM is likely to make adjustments to the Action Plan in response to any shifts in priorities, external factors such as actions by other agencies, and additional knowledge concerning the Reservoir and the effectiveness of watershed management methods.

Additional References

This plan update provides summary information of MDC/DWM's watershed protection program, including history, current status, goals, and activities planned for the next five years. More detailed information on a particular topic mentioned above may be obtained from MDC/DWM studies in the reference section of the complete WPP.

MDC/DWM's Commitment to Water Quality Protection

This Plan, together with professional staff and financial resources, represents a state-of-the art watershed protection program. DWM has an advanced understanding of the water quality, hydrology and hydrodynamics of the reservoir, potential pollution sources in the watershed, stormwater loads, and processes affecting tributary importance to the reservoir. With this on-site knowledge of the watershed system, DWM has crafted a program that meets the specific needs of the Quabbin Reservoir watershed and Ware River watershed. The Plan Update effectively protects and preserves the water quality of Quabbin Reservoir.

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MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
4.1 Land Acquisition		
1	Continue Land Acquisition Program	x
1a	Acquire lands in the Quabbin Reservoir Watershed.	x
1b	Acquire lands in the Ware River Watershed.	x
2	Utilize MDC/DWM's Land Acquisition geographic information systems models and other information.	x
2a	Ground check model with site walks.	x
2b	Incorporate advice from the LAPP to set land acquisition priorities.	x
2	Use services from MDC General Counsel to complete survey, title, engineering, and negotiation activities for new parcels.	x
4.2 Management of MDC/DWM Lands		
1	Develop and implement the *MDC/DWM* W*are River Watershed Land Management Plan*	x
1a	Review current management approach on all forested and non-forested lands to identify opportunities to modify approach to benefit other goals, including wildlife habitat manipulation, effective access control, and stormwater management.	x
1b	Define management goals for Ware River watershed forests and non-forests.	x
1c	Prepare plans for activities such as fire/access roads, bridges, restoration of newly acquired lands, forestry, monitoring of conservation easements and leases, and detailed inventories.	x
1d	Assess water quality impacts/benefits of planned activities.	x
1e	Prepare draft *MDC/DWM Ware River Watershed Land Management Plan.*	(1/01)
1f	Review plan with DWM staff and general public.	(1/02)
1g	Prepare final *MDC/ Ware River Watershed Land Management Plan.*	(1/03)
2	Complete assessment of all newly purchased lands, with maps and forest assessment based on field sampling.	x
3a	Continue to conduct selected silvicultural activities to attain water quality protection goal.	x
3b	Conduct inspections to ensure compliance with DWM's forestry BMP requirements.	x
4	Continue maintenance and annual assessment phases of the Quabbin Reservation White-tailed Deer Impact Management Program.	x

MDC/DWM Action Plan 2000-2004 **MDC/DWM Watershed Protection Plan Update** **Quabbin Reservoir Watershed and Ware River Watershed**		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
4.3 Public Access		
1	Continue full implementation and evaluation of the *MDC/DWM Public Access Plan - Quabbin Reservoir Watershed System*	x
1b	Continue full implementation and evaluation of the *MDC/DWM Public Access Management Plan Update - Ware River Watershed*	x
2	Continue to improve voluntary compliance with MDC/DWM's public access policies through the Watershed Ranger efforts of public education; ensure inter-departmental cooperation concerning access, recreational impacts, etc..	x
2a	Continue dawn to dusk patrols to provide patrol coverage of the watersheds.	x
2b	Continue using daily logbooks to record all encounters and violations.	x
2c	Create database and consider designating an administrative support person to aid in providing data to rangers on a call-in basis.	x
2d	Develop materials (e.g., brochures, etc.) to inform visitors of access rules, policies, and general watershed protection information.	x
3	Continue to ensure enforcement of public access regulations through partnership with the State Police, EPOs, and other local Police Departments.	x
4	Develop and install updated signs throughout the watersheds.	x
4b	Prepare a signage plan including signs announcing entry into the watershed, access/activity signs, and interpretative signs. Design signs to be easily understood, including colors and/or graphics.	x
5	Reduce the number of dogs observed within the gated areas of Quabbin Reservation to less than 10/year.	x
6	Complete the implementation of the bicycle policy.	x
6a	Enforce the existing rule that bicycling is not allowed on most watershed lands, and only in designated areas on designated routes.	x
6b	Install new signs with the universal symbol for no bikes.	x
7	Analyze water quality/erosion impacts of certain activities or sites as needed through watershed sanitary inspections.	x
8	Continue to deter unauthorized activities according to existing regulations and based on the policies of the public access management plans.	x
4.4 Additional Protected Lands		
1	Maintain an up-to-date inventory of additional protected lands.	x
1a	Conduct site visits to each of the key properties to identify and evaluate their land management practices; provide suggestions for improvements if needed.	x

MDC/DWM Action Plan 2000-2004 **MDC/DWM Watershed Protection Plan Update** **Quabbin Reservoir Watershed and Ware River Watershed**		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
2	Maximize the watershed protection value of lands owned and managed by DEM and MDFW.	x
3	Ensure that towns are following proper land management practices on conservation and town forest properties.	x
3a	Conduct an inventory of town land management practices.	x
3b	Through the Community Technical Assistance program (**Section 5.3**), provide guidance and education to improve such practices.	x
3c	Conduct follow-up assessments on any problem properties.	x
4	Keep existing Ch. 61, 61A, and 61B lands in that status, encourage listing of additional lands to remove such lands from potential development pool, and assess any lands that change status.	x
4a	Evaluate the priority of MDC/DWM acquisition of any protected land that has a status change during the next five years.	x
4b	Periodically track, through available maps and databases, the additional preserved lands; Identify any trends or significant changes in Chap 61, 61A & 61B lands.	x
5	Confirm that private forest lands are forested in compliance with State regulations.	x
5a	Continue to implement the Private Lands Forestry program, send an annual newsletter, fund forest management plans, and encourage the use of BMPs via the green certification program.	x
5b	In concert with DFA and local boards, assess activities on Chapter 61, 61A & 61B lands to ensure that all state required BMPs are followed.	x
6	Investigate acquiring an interest, via conservation restriction, in targeted preserved open space properties.	x
6a	Investigate legality of holding conservation restrictions on municipal land.	x
7	Continue involvement and support of the NQRLP and resulting collaborative efforts on land protection projects in the watersheds.	x
5.1 Watershed Protection Regulations		
1	Continue to implement the MDC Watershed Protection regulations.	x
2	Continue to administer individual WsPA applications under 350 CMR 11.00.	x
3	Continue to meet regularly as the WsPA Implementation group (WsPAWG).	x
4	WsPAWG will continue to refer projects to the EQ section and Superintendent.	x

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
5	Continue to educate and interact with local boards about Watershed Protection regulations.	x
6	Maintain and update technical tools of regulatory implementation.	x
7	Revise WsPA forms and applications as well as WsPA Guidance Document, for applicants and landowners.	x
5.2 Major Environmental Regulations		
1	Continue to use site inspections, watershed sanitary surveys, local board coverage, and Watershed Rangers to identify possible violations of state and federal regulations.	x
2	Improve coordination with DEP to enforce environmental regulations; continue implementation of enforcement protocol with DEP.	x
3a	Continue to coordinate with other agencies of exchanging information and coordinate review of state projects.	x
3b	DWM will send staff to DEP and other professionally sponsored training sessions on Title 5, septic inspections, wetland delineation, and other state laws.	x
5.3 Community Technical Assistance		
1	Meet, as needed, with local boards.	x
2	Provide direct technical assistance support to local boards and community organizations upon request from communities, through contact at board meetings and/or through regulatory review process.	x
3	Track changes in local bylaws for watershed protection.	x
4	Administer grants and contracts for community planning projects. DWM staff will work with municipalities to identify projects with common interests, and identify the greatest needs, in terms of watershed community bylaws; help towns scope projects. DWM will request and allocate funding for the technical assistance program.	x
5	Continue to provide input at the state level through the legislative process, to revise both the Zoning Act and Subdivision Control Law in a manner such that local regulatory mechanisms may be strengthened relative to watershed protection.	x
6	Continue to research and provide monographs on selected topics relative to watershed protection.	x
7	Develop and fund grant program to strengthen local planning capability. Provide necessary administration and oversight.	x
8	Produce 'fact sheets' and brochures.	x

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
5.4 Public Education		
1a	Expand the Quabbin Reservoir watershed curriculum using various curriculum materials developed by MWRA, DEP, EPA, ProjectWild, Project Learning Tree, Project WET, and other appropriate watershed resources.	x
1b	Continue to support Project WET and teacher training opportunities to watershed school system teachers through in-service workshops and day-long offerings; conduct follow-up interviews with teachers to determine any needs particular to Quabbin area.	x
1c	Continue to offer in-school programs to Quabbin Reservoir and Ware River watershed school systems.	
1d	Continue to offer field trips for schools in the Quabbin Reservoir and Ware River watersheds.	x
1e	Continue to offer field trips for schools in the Quabbin Reservoir and Ware River watersheds.	x
2a	Continue/expand collaboration with other organizations and watershed communities to reach a more diverse audience; Identify specific groups and their educational needs.	x
2b	Develop suitable portable exhibits for use in talks and presentations.	x
2c	Expand self-guided interpretive trails focusing on natural resource management and water quality protection; include interpretive signs with information related to DWM watershed protection programs, forest succession, history of the reservoir, wildlife.	x
2d	Coordinate with visiting groups to provide orientation at the Visitor Center.	x
3a	Expand resource center materials with educational information on the watershed system, water quality, history and development of the watershed and water supply system, water pollution, and water supply protection and management.	x
3b	Continue development of watershed exhibits for display in the Visitor Center, watershed community libraries, and local events.	x
3c	Offer a speakers bureau through which outside organizations may request speakers with particular expertise in a variety of environmental, water resource, wildlife, and watershed protection issues.	x

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
4	Provide input on "fact sheets" responsive to public interests (in conjunction with community technical assistance program) dealing with issues such as on-site wastewater disposal, stormwater management, household hazardous waste disposal, and MDC regulations.	x
5	Work with other DWM sections to develop and maintain a site on the World Wide Web to offer information on access, rules, stewardship and other areas of watershed protection interest, and links to related sites.	x
6	Improve the Quabbin signage program (in conjunction with the implementation of the Public Access Plans), including interpretive signs, directional signs, and clear signs indicating access restrictions; coordinate purchase, installation, and implementation of a sign machine.	x
7	Provide graphics support to Division staff to increase quality and effectiveness of publications, brochures, and public documents.	x
6.1 Wildlife		
1a	Continue year-round effort of active harassment of birds using human presence, boats, pyrotechnics, passive scare devices, and newly developed techniques.	x
1b	Continue to identify and test new harassment techniques. Research, design, develop, construct, and deploy new bird harassment techniques.	x
1c	Work with DEP to ensure bird control requirements are enacted at regional landfills and other food sources. Provide technical assistance on harassment methods to landfill operators as requested.	x
2a	Develop and implement a Canada geese control program and treat laid eggs to prevent hatching.	x
2b	Monitor results of Canada geese control program.	x
3a	Establish "Control Zone" concept and continuing permit through agreement with MDFW, DEP, and other agencies.	x
3b	Conduct year-round effort to identify populations of beaver and muskrat within the defined protection zone.	x
3c	Control beaver and muskrat populations within the Pathogen Control Zone using trapping and shooting.	x
3d	Implement habitat manipulation to control and discourage populations within the protected zone.	x

MDC/DWM Action Plan 2000-2004 **MDC/DWM Watershed Protection Plan Update** **Quabbin Reservoir Watershed and Ware River Watershed**		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
4	Continue ongoing research with the University of Massachusetts-Amherst to develop methods to identify and track pathogens in the watersheds (see **Section 8.1**).	x
6.2 Agriculture		
1	Encourage BMPs/monitor impacts of small sites.	x
1a	Include agricultural operations as part of the watershed sanitary survey process.	x
1b	Research and develop agricultural BMPs and BMP implementation approaches for small-scale, horses and cattle operations in the watersheds.	x
1c	Prepare and distribute literature concerning agricultural BMPs for hobby farms, and information regarding funding/grant sources for BMPs.	x
2	Coordinate with DFA and DEP on watershed agricultural issues.	x
3	Support efforts by DEP and other groups to promote reduction of chemicals for lawn care by homeowners in the watershed.	x
4	Continue to network with New York City DEP and other water supply agencies to keep informed of agricultural BMP issues.	x
6.3 Wastewater Disposal		
1	Develop and distribute public education materials on: 1) solutions to on-site septic system problems; 2) proper operation and maintenance of on-site systems; and 3) financing options for on-site systems repairs and installations.	x
2	Provide technical assistance to towns and/or neighborhood associations to consider/evaluate on-site wastewater management district.	x
3	Initiate Septic System Database Project.	x
3a	Link the parcel-specific database with DWM's GIS database.	x
3b	Provide follow-up training and assistance to BOHs to make the best use of what will be a comprehensive collection of septic system information for each community.	x
3c	Identify and track potential problem systems and follow up with owners, local BOH, and DEP.	x
4	Continue to monitor and enforce the provisions of Title 5 with BOHs and DEP.	x
5	Provide technical assistance and funding assistance, where appropriate, to towns on wastewater disposal issues.	x

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
6.4 Stormwater		
1a	Assess the recommendations of the Wachusett Stormwater Management Study (CDM) and apply to the watersheds of the Quabbin Reservoir and Ware River.	1/01
1b	Coordinate with interested towns to develop townwide stormwater management plans.	1/01
2	Develop Stormwater Project Lists; show priorities and target time frames for top priorities.	1/01
3a	Implement minor stormwater BMPs around the reservoir, including stormwater BMPs to address erosion and sedimentation due to public access, stormwater runoff, and shoreline erosion.	x
3b	*Construct stormwater BMPs on MDC/DWM property in accordance with set priorities.	x
4a	*Advise local boards on Massachusetts Stormwater Management Policy.	x
4b	Coordinate with MHD to improve water quality from state highway drainage.	x
6.5 Visitor Sanitation		
1	MDC/DWM will monitor and assess visitor use patterns to adjust the Sanitation Program, beginning with a needs assessment of DWM lands on the West Branch of the Swift River.	x
7.1 Highways and Railways		
1	Implement recommendations from the Transportation Release Controls Study, in coordination with MHD and other transportation entities. Develop a program of recommended improvements after inspecting the areas of concern.	x
2	Establish budget for special projects to be conducted each year in accordance with the proposed implementation of recommendations of the Transportation Release Controls Study.	x
3	Coordinate with MHD and local DPWs to continue to implement highway BMPs along state highways and smaller roads within the watersheds.	x
4	Coordinate with DWM staff to implement BMPs on MDC/DWM maintained roads.	x
5	Locate, map, and assess untreated stormwater discharges from highways to tributaries in the watersheds.	x
6	Establish consultant contract to locate and map stormwater conveyance structures within the watersheds.	x

MDC/DWM Action Plan 2000-2004 **MDC/DWM Watershed Protection Plan Update** **Quabbin Reservoir Watershed and Ware River Watershed**		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
7	Continue to monitor YOP implementation for railroad right-of-way maintenance by field verifying protection zones. Coordinate with DFA-PB, as necessary.	x
8	Establish contracts to refine hydrodynamic modeling of the Quabbin Reservoir and its watershed.	x
7.2 Individual Contaminated/Suspected Sites		
1	Monitor the DEP hazardous materials release database and follow-up and inspect sites within the watersheds.	x
2	Investigate contaminated sites and hazardous waste generators through coordination with DEP/WSC and the watershed sanitary survey process.	x
3	Monitor Underground Storage Tank pulls in the watersheds through cooperation with local Fire Departments. Receive notification of leaks and spills.	x
4	Monitor landfill closures and risk assessments through cooperation with DEP/Solid Waste.	x
5	Inventory commercial USTs in the watersheds.	x
7.3 Emergency Planning & Response		
Hazardous Materials Data and Reduction		
1	Contact appropriate Federal and State agencies to compile a database of the types and quantities of hazardous materials transported through the watersheds.	x
2	Determine the appropriate paths of communication with Federal and State agencies to reroute hazardous materials from highways and railways in the watersheds; Coordinate with the appropriate authorities to assess rerouting of hazardous materials transported by highway and railway in the watersheds.	x
3	Maintain DWM's databases to establish locations of hazardous material generators in the watersheds.	x
4	Request Federal Form R's – Toxic Chemical Release Inventory forms.	x
5	Coordinate with DEP to enhance the source reduction efforts in the watersheds; determine if DWM could improve the current efforts in the watershed to reduce the need and the use of hazardous materials by industries in the watersheds.	x
Emergency Response Planning		

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
6	Develop a mailing to industries regarding the federal requirements to notify of a release and to have an Emergency Response Plan under SARA Title III.	x
7	Contact MEMA to improve the template used to update each community's emergency response plan, by adding an additional template to document current equipment and notification information.	x
8	Advocate to MEMA for the regionalization of the emergency planning committees so that it occurs along watershed boundaries.	x
9	Coordinate Emergency Response Plan with MWRA.	x
Highways/Railways		x
10	Coordinate with MHD to erect signs that note entry into the Quabbin Reservoir watershed and Ware River watershed as drinking water supply watersheds.	x
11	Monitor inspection frequency of rails along no-spray and limited spray zones.	x
Training		x
12	Encourage all Fire Departments to receive "Operations Level" and "Incident Command" training	x
13	Encourage all watershed police departments to receive "Awareness Level" training	x
14	Investigate the development of a grant program to the watershed communities to make the appropriate training affordable to the Fire and Police departments.	x
15	Attend incident command system (ICS) training conducted by MWRA.	x
16	Contact training professionals to conduct 'Awareness Level' training for appropriate DWM staff.	x
17	Coordinate with other State agencies to conduct a mock hazardous materials release on the roadways/railways to assess the adequacy of the response system.	x
Response Equipment		x
18	Ensure that each watershed community has adequate equipment to respond to an anticipated hazardous materials release.	x
19	Purchase and establish the reservoir response units that would be equipped to contain releases into the reservoir.	x
7.4 Construction Sites (all activities listed under other programs)		

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
7.5 MDC/DWM Infrastructure and Maintenance		
1	Conduct monthly inspections and issue findings on Winsor Dam and Spillway, Goodnough Dike, MDC/DWM Bridges and Small Dams.	x
2	Implement maintenance activities as needed on Winsor Dam and Spillway, Goodnough Dike, MDC/DWM Bridges and Small Dams.	x
3	Continue building maintenance activities, including well replacement and septic system monitoring.	x
4	Conduct truck, boat, and equipment inspections and maintenance as needed.	x
5	Continue the safe and legal operation of the boat and shoreline fishing program.	x
8.1 Monitoring Programs		
1	Integrate UMass monitoring of TOC, UV, etc. into MDC/DWM routine monitoring schedule.	x
2	Continue pathogen monitoring program.	x
3	Enhance the algae monitoring program.	x
4	Support and utilize the UMass Coliphage study.	x
5	Expand the nutrient-algae investigations in the Quabbin Reservoir.	x
8.2 Flows		
1	Continue use and operation of stream gages, groundwater monitoring wells, and periodic published reports of data.	x
2	Collect field data.	x
3	Continue stormwater flow monitoring	x
4	Assess need to continue development/refinement of 2-dimensional water quality model of Quabbin Reservoir.	x
8.3 Watershed Sanitary Surveys		
1	Complete MDC/DWM watershed sanitary surveys in the Quabbin Reservoir watershed and the Ware River watershed on the prescribed cycle and conduct remediation actions, as necessary.	x
2	Develop and maintain watershed sanitary survey database.	x
9.0 Other Activities		
	Write Annual WQ reports.	x
	Continue Trend Analysis for Tributaries.	x
	Continue Trend analysis for Reservoir.	x
	Continue Biomonitoring.	x

MDC/DWM Action Plan 2000-2004 MDC/DWM Watershed Protection Plan Update Quabbin Reservoir Watershed and Ware River Watershed		
Plan Section/ Number in Text	**Watershed Protection Activity**	**On-going 2000 –2004 (due date)**
	Conduct Macrophyte surveys.	x
	Continue Administrative duties.	x
	Continue maintenance of WQ Lab.	x
	Continue maintenance of Bacterial Lab.	x

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Section 1
Introduction

1.1 Background

The *MDC/DWM Watershed Protection Plan Update 2000* for the Quabbin Reservoir Watershed and Ware River Watershed advances, rather than replaces, MDC/DWM's 1991 *Watershed Protection Plan for the Quabbin Reservoir and Ware River Watersheds*. The *MDC/DWM's Watershed Protection Plan Update for Wachusett Reservoir Watershed* prepared in 1998 remains in effect. Even though this plan is for the Quabbin Reservoir Watershed and Ware River Watershed, specific information is given for all three MDC/DWM watersheds–Quabbin Reservoir, Ware River, and Wachusett Reservoir–based on their interdependence.

1.1.1 Metropolitan Boston Water System Sources

The Massachusetts Water Resources Authority (MWRA) and the Metropolitan District Commission (MDC) Division of Watershed Management (DWM) currently supply drinking water to 46 communities, 2.5 million people and 5,500 industrial users, in the metropolitan Boston area.[1] MWRA is responsible for treatment and transmission, while MDC/DWM is responsible for collection and safe storage of water, protection of reservoir water quality, and management of the watersheds.

Figure 1-1 presents a system schematic. Quabbin Reservoir, the Ware River, and Wachusett Reservoir are the active water supply sources for the metropolitan Boston water system. Ware River water is transferred seasonally to Quabbin Reservoir, while Quabbin Reservoir water is transferred regularly to Wachusett Reservoir through the Quabbin Aqueduct. Wachusett Reservoir is the terminal supply reservoir of the Cosgrove Intake. Water is withdrawn through the Cosgrove Intake at the eastern end of Wachusett Reservoir, and is carried by the Cosgrove Tunnel to the distribution system. The Sudbury Reservoir is an emergency backup supply for metropolitan Boston. Quabbin Reservoir is the terminal supply reservoir for the Chicopee Valley Aqueduct serving three Western Massachusetts communities. MDC/DWM and MWRA also provide water to the Chicopee Valley Service Area, which includes 95,000 people in three communities (Chicopee, South Hadley Fire District and Wilbraham) served by the Quabbin Reservoir alone.

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[1] Three communities southwest of Quabbin Reservoir, Chicopee, Wilbraham, and South Hadley Fire District #1, obtain their water directly from the Quabbin Reservoir through the Chicopee Valley Aqueduct.

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GENERAL PLAN of the MDC-DWM/MWRA WATER SUPPLY SYSTEM

WATERSHEDS, RESERVOIRS, INFRASTRUCTURE and USER COMMUNITIES

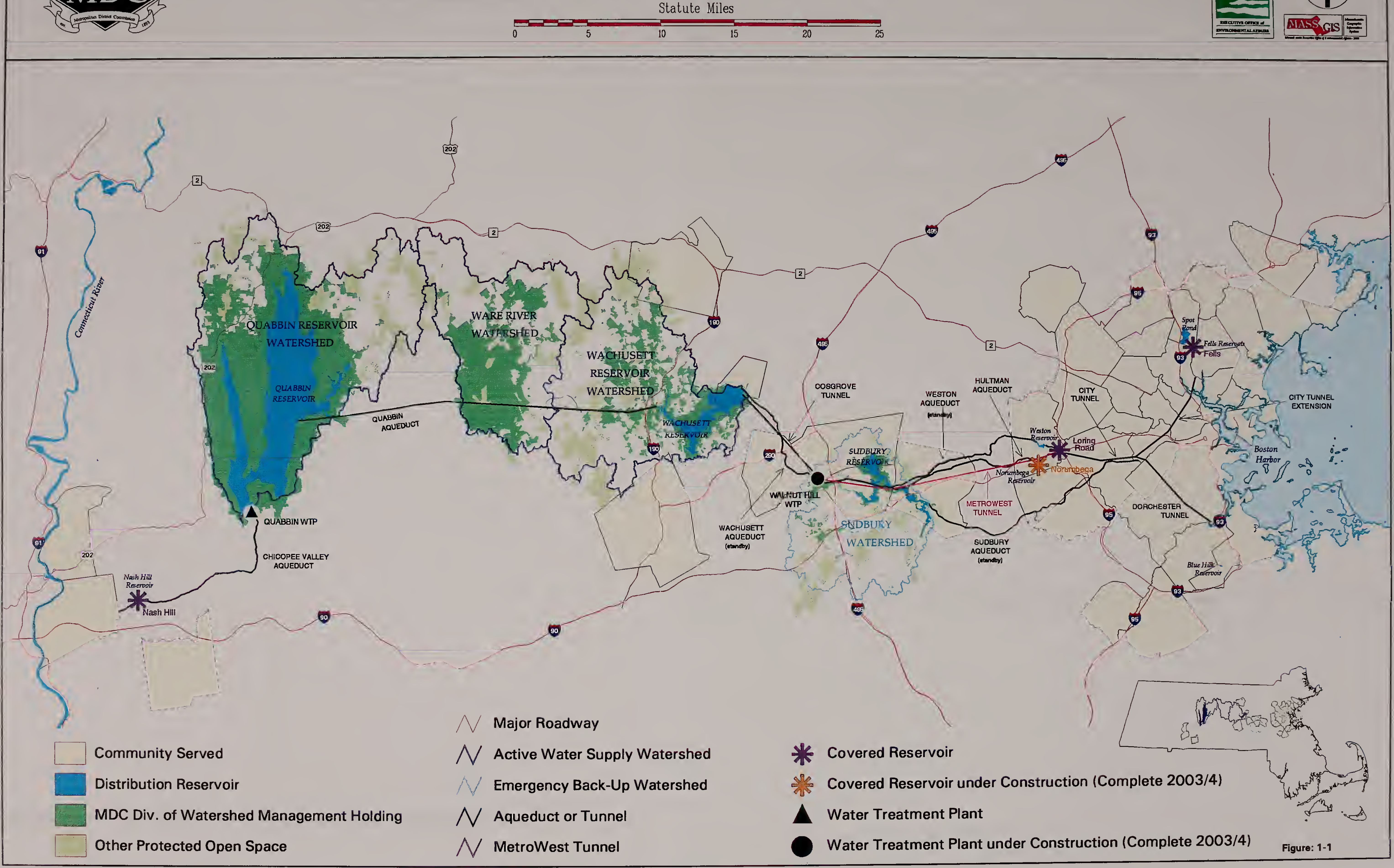
Statute Miles
0
5
10
15
20
25
Connecticut River
91
202
2
QUABBIN RESERVOIR WATERSHED
QUABBIN RESERVOIR
QUABBIN AQUEDUCT
QUABBIN WTP
CHICOPEE VALLEY AQUEDUCT
Nash Hill Reservoir
Nash Hill
WARE RIVER WATERSHED
WACHUSETT RESERVOIR WATERSHED
WACHUSETT RESERVOIR
190
90
495
290
COSGROVE TUNNEL
WACHUSETT AQUEDUCT (standby)
WALNUT HILL WTP
SUDBURY RESERVOIR
SUDBURY WATERSHED
WESTON AQUEDUCT (standby)
HULTMAN AQUEDUCT
METROWEST TUNNEL
SUDBURY AQUEDUCT (standby)
Weston Reservoir
Loring Road
Norumbega Reservoir
Norumbega
CITY TUNNEL
DORCHESTER TUNNEL
CITY TUNNEL EXTENSION
Spot Pond
Fells Reservoir
Fells
Boston Harbor
Blue Hill Reservoir
93
95
Major Roadway
Active Water Supply Watershed
Emergency Back-Up Watershed
Aqueduct or Tunnel
MetroWest Tunnel
Community Served
Distribution Reservoir
MDC Div. of Watershed Management Holding
Other Protected Open Space
Covered Reservoir
Covered Reservoir under Construction (Complete 2003/4)
Water Treatment Plant
Water Treatment Plant under Construction (Complete 2003/4)

Figure: 1-1

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The past decade's withdrawals from each source water supply are summarized in **Table 1-1** below:

Table 1-1

MDC/DWM Watershed Areas and Withdrawals from System Sources

Source	*Watershed Area*[1] *square miles & acres*	*Net Average Annual Withdrawal*[2] *(mgd)*	*Average Annual Withdrawal*[2] *(mgd)*
Ware River (MWRA Intake)	96 mi² & 61,740 acres	NA	20.06
Quabbin Reservoir	187 mi² & 119, 940 acres	78	206.34
Wachusett Reservoir	117 mi² & 74,890 acres	256	255.65
MDC/DWM-MWRA Water Supply System Total	401 mi² & 256,570 acres	334	482.05

[1] Including area of reservoir surface for Quabbin Reservoir and Wachusett Reservoir.
[2] Source: (MWRA, 2000) – 10 Year period used (August 1990-July 2000 inclusive).

Safe Yield Estimation Model - MDC/DWM-MWRA Water Supply System

Safe yield is a mathematically derived value that serves as an index of a system's ability to supply water on a continuous basis during a critical drought, expressed in million gallons per day (mgd). Thus, the derivation of a safe yield value has many associated constraints and assumptions. At the time of publication, the MDC/DWM and MWRA use a safe yield value of 300 mgd based on several assumptions. These assumptions include:

- The Ware River watershed, Quabbin Reservoir watershed, and Wachusett Reservoir watershed are functioning as an integrated system;
- The minimum pool levels in reservoirs would not be violated. Quabbin Reservoir minimum pool level is 490 feet (38% capacity). Wachusett Reservoir minimum pool level is 388 feet (85% capacity); and
- A feasible and acceptable drought management plan was included in the analysis (a surrogate reliability of 99.1%).

These conditions produce a mathematical safe yield of 294 MGD; however, since the analysis only used a 50 year record (1930-79), which included the 1964-66 drought (estimated as a rare, 147 year event), the MWRA selected a (derived) safe yield of 300 MGD. This is reported in detail in "Task 4: Safe Yield-Existing System" (Little, 1983).

1.1.2 Contributing Watersheds

The two contributing watersheds to Quabbin Reservoir water (Quabbin Reservoir and Ware River watersheds) total 181,680 acres. Each watershed is predominantly forest, with some developed suburban and rural land uses. As of 2000, MDC/DWM owns and manages about 42% of the three watersheds' area, and other agencies, municipalities and private agencies protect another 21% of the three watersheds' area (see **Section 4.4**).

Quabbin Reservoir Watershed

The Quabbin Reservoir watershed consists of 119,940 acres, including the reservoir surface that is approximately 25,000 acres at elevation 530'. A significant portion of the Quabbin Reservoir's annual inflow is from direct precipitation that contributes about 30% annual inflow. Direct inflow is also significant, contributing 17% of annual inflow, which is about the same magnitude as its largest tributary, the East Branch of the Swift River. Other Quabbin Reservoir watershed tributaries include: the West and Middle branches of the Swift River, and Hop, Fever, and Dickey Brooks. Quabbin Reservoir also receives about 9% of its annual flow from transfers of water from the Ware River at the MWRA intake. Ware River water transfers enter Quabbin Reservoir above the area of the intake and, due to a baffle dam, these transfers travel several miles and mix with Reservoir water before reaching the Quabbin Aqueduct intake. This process provides significant travel time (on the order of several years) allowing color and suspended solids in Ware River inflows to settle prior to reaching the intakes. About 93.3% of the aggregated land use/land cover in the Quabbin Reservoir watershed and Ware River watershed land cover is undeveloped forest, wooded wetland, wetland, upland, open upland, and open water (**Figure 2-2**). The remaining 6.7% of the aggregated land cover/land is developed including uses such as agriculture (3.6%), residential (2.1%), other developed (0.8%), and relatively few commercial uses (0.2%), most in the distant, upper portions of the watershed (**Section 2.1**). Twelve municipalities are wholly or partially located in the watershed: Athol, Barre, Belchertown, Hardwick, New Salem, Orange, Pelham, Petersham, Phillipston, Shutesbury, Ware, and Wendell.

Ware River Watershed

The Ware River watershed totals 61,740 acres. Ware River transfers are authorized between October 15 through June 15, and only river flows exceeding 85 MGD can be diverted (Ch. 375 Acts of 1926)[2]. The transfers to Quabbin Reservoir are also limited to times when the Quabbin Aqueduct is not being used to transfer Quabbin water to Wachusett Reservoir. Ware River water is transferred to Quabbin Reservoir based on an operating rule which considers reservoir levels and seasonal hydrologic conditions[3]. Eight towns are wholly or partially located in the Ware River watershed: Barre, Hubbardston, Oakham, Phillipston, Princeton, Rutland, Templeton, and Westminster. About 86% of the Ware River watershed land cover is forested and wetlands, with the following land uses: 5% agriculture, 3% residential development, and the remainder consisting of commercial/industrial and other uses (**Section 2.1**).

Wachusett Reservoir Watershed

The Wachusett watershed is about 74,890 acres in area, including the reservoir, and features an extensive network of streams and rivers feeding the reservoir. Quabbin transfers are the largest source of inflow to Wachusett on an annual basis (about 50%). The largest tributaries, Stillwater and Quinapoxet Rivers, together contribute another 30% of annual inflow from 75% of the watershed area. Both rivers, as well as Quabbin transfers, flow into Thomas Basin at the western end of the reservoir. Due to the constricted outflow from the basin into the main body of the reservoir, Thomas Basin acts as a sedimentation basin for almost 90% of Wachusett Reservoir inflows. This important feature contributes significantly to the reservoir's excellent water quality.

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[2] The diversion cannot be made between June 1 and December 1 without permission of the State Department of Public Health.

[3] Since 1992, MDC/MWRA operating policy has been to divert Ware River to Quabbin Reservoir only, although Ware River water can be transferred directly to Wachusett Reservoir using the Quabbin Aqueduct.

About 75% of the watershed is currently undeveloped forests and wetlands, including 52% MDC-owned or conservation land. The remaining 25% of the watershed includes 8% agriculture use, 9% residential use, less than 1% commercial office or industrial uses and 7% in other uses, including transportation facilities (several highways and a railroad) and recreation. Most of the watershed lies within the boundaries of five municipalities (Boylston, West Boylston, Holden, Sterling, and Princeton), though parts also extend across and into seven other municipalities' boundaries (Clinton, Worcester, Paxton, Rutland, Hubbardston, Westminster, and Leominster).

1.2 Purpose

1.2.1 Previous Plans

In 1991, MDC and MWRA developed two watershed protection plans (referred to as WPPs or Plans): one plan for activities in the Wachusett Reservoir watershed and another plan for activities in the Quabbin Reservoir/Ware River watersheds. These were the first formal written plans for managing the watersheds.

The Quabbin Reservoir/Ware River Plan was submitted to Massachusetts Department of Environmental Protection (DEP) in conjunction with a request for a waiver from filtration for the Chicopee Valley Aqueduct system in 1991[4]. MDC's implementation of the Plan began in 1991. DEP approved the Plan in January 1992 (DEP, January 24, 1992).

The Wachusett Reservoir Watershed Protection Plan was not immediately submitted to DEP for approval since a filtration waiver was not initially requested for that source in 1991. However, MDC did begin implementation of the Wachusett Plan in January 1992. In June 1993, MWRA, MDC, and DEP entered into a consent order establishing the "dual track" approach to determine treatment requirements of the metropolitan Boston system. Thus, it was not until September 1993 that the Wachusett Plan was submitted to DEP for formal approval, along with the addendum "Updated Information to Accompany the Submittal of the Watershed Protection Plan, Wachusett Reservoir Watershed." The addendum included a schedule proposing activities to implement the Plan through 1998.

In a letter dated May 24, 1994, DEP found the Wachusett Reservoir Plan to be in accordance with DEP Policy 89-09 and DEP's guidance document (see footnote #4), and commented that the Plan was comprehensive. DEP also approved the Implementation Schedule with one modification concerning the state's Title 5 regulations, which were being revised at the time. DEP's letter also includes an attachment, essentially calling for prevention of waterborne disease as the top priority.

Thus, both the Quabbin Reservoir Watershed /Ware River Watershed and Wachusett Reservoir Watershed Protection Plans have been approved by DEP and have formed the basis for DWM's programs since 1991.

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[4] The process for filtration avoidance is outlined in Massachusetts regulations (314 CMR 22.20A) and the federal Surface Water Treatment Rule (40 CFR Parts 141 and 142, 1989), and includes the requirement that the water supplier submit a Watershed Protection Plan.

1.2.2 Need for Plan Update

Since the original Plans were prepared in 1991, MDC/DWM has greatly expanded its watershed protection programs. MDC/DWM has expanded its program with many activities including:

- Completing a reservoir model;
- Implementing on-going watershed sanitary surveys;
- Passing and implementing watershed land use regulations (Watershed Protection Act/Watershed Protection regulations;
- Instituting successful wildlife control programs;
- Developing a leading-edge land acquisition model and purchasing thousands of acres of watershed lands;
- Broadening on-going stormwater sampling and related studies;
- Creating wastewater pilot projects;
- Undertaking a transportation risk assessment;
- Completing an agriculture inventory;
- Establishing a watershed ranger program;
- Sponsoring various public education programs; and
- Updating Public Access Management and Land Management Plans.

These measures have augmented DWM's understanding of potential watershed contamination sources, their influence on intake water quality, and the most feasible and effective control approaches. Another reason for the Plan update is the high priority concern of the EPA and DEP, that focuses on the threat of *Giardia* and *Cryptosporidium* pathogens. The studies conducted by DWM concerning watershed processes and potential pollution sources, along with the federal and state agencies' increased focus on pathogens, have advanced the MDC/DWM watershed protection program beyond the original framework provided by the 1991 Plan.

During this period, MWRA also conducted a series of studies and plans to determine its approach to system treatment. MWRA evaluated both filtration and non-filtration alternatives to comply with the Safe Drinking Water Act (SDWA) regulations. In October 1998, MWRA and MDC/DWM submitted an application for a waiver from the filtration requirement for the Wachusett Reservoir. As a component of the application for this waiver, in response to requests from DEP (through annual on-site inspections) and U.S. EPA, and due to an increased knowledge of watershed features, MDC/DWM and MWRA were committed to update the Quabbin Reservoir Watershed and Ware River Watershed Protection Plan.

Both MWRA and MDC are dedicated to watershed protection as part of a multi-barrier approach to drinking water quality, regardless of the treatment system. This Plan Update provides an opportunity to consider the significant expansion of DWM's programs since 1991, the increased knowledge of water quality and watershed sources of concern, and sets a focused watershed protection agenda for the next five years.

1.3 Regulations and Policies Concerning Watershed Protection Plans

This Plan Update is intended to provide DWM with a focused program of activities for the next five years, reflecting the agency's goals and priorities, and to satisfy DEP and EPA criteria for watershed protection. The Plan's content has been organized to address the various regulations and guidelines pertaining to adequate watershed protection, namely:

- EPA, Surface Water Treatment Rule (1989) (also promulgated by DEP)
- EPA, Guidance Manual for Compliance with the Filtration and Disinfection Requirement (1990)
- EPA, Interim Enhanced Surface Water Treatment Rule (1998)
- DEP, Policy 89-09, Watershed Resource Protection Plan Policy (1990)
- DEP, Guidance on the Preparation of a Watershed Resource Protection Plan (1990)
- DEP, Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Supplies to Obtain, and Maintain, a Waiver from Filtration Requirements ("Measures of Success") (1996)
- DEP, "Developing a Local Surface Water Supply Protection Plan" (1996)
- DEP/EPA, "State Source Water Assessment & Protection Program Guidance" (1997)
- EPA/HDR/SAIC, "Revised Draft - Unfiltered Water Supply Systems Guidance Manual" (1999)

These documents' requirements and guidelines for watershed protection plans, and for how such requirements are reflected in this 2000 Plan Update, are described below.

1.3.1 Surface Water Treatment Rule (SWTR)

The federal SWTR regulations were promulgated in June 1989 to reduce the risk of waterborne disease from microbial pathogens.

The SWTR requires filtration for all surface drinking water supplies, unless the water supply meets specific criteria to qualify for a waiver. One of these criteria is an adequate watershed control program. The rule emphasizes the need for the watershed control program "to minimize the potential contamination by *Giardia* cysts and viruses in the source water."

The SWTR establishes minimum requirements of the watershed control program as:

- Assessing the hydrology, land cover, and land use characteristics of the watersheds;
- Describing activities or characteristics of the watershed that may impact source water quality adversely; and
- Monitoring and controlling these activities or characteristics.

In addition, the SWTR also requires that the public agency responsible for watershed management demonstrates control over the watershed's land, either through land ownership or through agreements with private land owners. There must also be an annual survey by the primacy agency (in this case, DEP) that documents the effectiveness of the watershed control program.

This 2000 Plan Update includes all required elements: **Section 2** addresses hydrology and land use, **Section 4** describes control of watershed lands, **Sections 5 through 7** identify potentially adverse activities and their controls, and **Section 8** addresses monitoring.

1.3.2 EPA Guidance Manual for Compliance with the Filtration and Disinfection Requirement

The SWTR contains few specific requirements for watershed control, beyond the general topics listed above. EPA's interpretation and application of the SWTR watershed control requirement is described in the *Guidance Manual for Compliance with the Filtration and Disinfection Requirement for Public Water Systems Using Surface Water Sources* (EPA, October 1990).

This manual presents advisory guidelines to primacy agencies. It defines a watershed control program as "a surveillance and monitoring program which is conducted to protect the quality" of a source. Specific elements of a watershed control program are recommended, each of which is addressed in this 2000 Plan Update as shown below in **Table 1-2**.

1.3.3 EPA Interim Enhanced Surface Water Treatment Rule (IESWTR)

In December 1998, EPA promulgated the Interim Enhanced Surface Water Treatment Rule (IESWTR). The IESWTR builds on the SWTR, adding requirements of treatment and control for *Cryptosporidium*. The IESWTR adds the specific requirement that the water system must maintain the watershed control program to minimize the potential for *Cryptosporidium* contamination, including identifying and monitoring watershed characteristics and activities that may have an adverse effect on water quality. In the IESWTR, EPA states that "It appears that unfiltered water systems that comply with the source water requirements of the SWTR have a risk of cryptosporidiosis equivalent to that of a water system with a well-operated filter plant using a water source of average quality." EPA plans to continue to evaluate this issue when additional data becomes available.

Two components of the IESWTR include the following provisions: a) A Maximum Contaminant Level Goal (MCLG) of zero is established for the protozoan genus *Cryptosporidium*; and b) Surface water systems that are required to filter under the SWTR must achieve at least 2 log removal of *Cryptosporidium*. This Plan Update has been prepared to minimize potential for water contamination from *Cryptosporidium*, as well as *Giardia* and pathogenic bacteria and viruses.

1.3.4 DEP Policy 89-09 and Guidance on the Preparation of a Watershed Resource Protection Plan

In January 1990, DEP issued Policy 89-09, *Watershed Resource Protection Plan Policy*, which concerns the minimum information to be included in a watershed plan submitted under the SWTR filtration avoidance procedures. The Policy requires the same six elements identified in the EPA Guidance Manual. In addition, the Policy identifies a series of map overlays to be prepared, and some additional detail concerning the contents of the six elements.

This plan includes all the content requirements. Maps are being provided in ARC/INFO format, and are compatible with MassGIS and DEP standards. **Table 1-2** summarizes DEP Policy 89-09 along with notations of where each requirement is contained in this Plan Update.

Table 1-2

Location of EPA Guidance Manual and DEP Policy 89-09 Requirements in Plan Update

Item	***Plan Update Section***
Report Submission	
■ Narrative	Executive Summary
■ Maps	Throughout Plan
A. Watershed Description	2
■ Location of major physical features and system components	2
- Watershed zones A, B, C	2.5
■ Hydrological characteristics	2.3
B. Identification of Watershed Characteristics and Activities Detrimental to Water Quality	2, 5, 6, 7
■ Naturally occurring sources	
- Erosion potential	2
- Animal populations	6.1
■ Manmade contamination sources	5, 6, 7
- Activities subject to state/federal approval	5.2
- Sewered areas	6.3, Fig. 2-2
- Gas stations and petroleum storage	7.2, 5.2
- Zoning	2.2, Fig. 2-2
- Land use	2.2, Fig. 2-2
- Hazardous waste sites	7.2, 5.2
C. Risk Assessment and Control of Detrimental Activities/Events	
■ Summarize results and assess risk	3.3, 4, 5, 6, 7
■ Control mechanisms	4, 5, 6, 7
D. Monitoring	8
■ Source water information	2.4
- Monitoring sites	Fig. 8-1
E. Agreements and Delineation of Land Use/Ownership	
■ Land ownership	2.2, 4.1, Fig. 2-3
■ Efforts to obtain ownership	4.1
■ Efforts to obtain agreements and control	4.4, 5.1
■ Compliance with agreements	4.2, 4.4
F. Management/Operations	
■ Management	9
- Organization structure	9.1
- Staff requirements	9.1
- Staff education, certification, and training	9.1
- Annual report	9
■ Operations	
- Ongoing patrol to identify and react to potential impacts	4.3, 8.3
- Emergency response plan; Operational changes	7.3,3.2

DEP-DWS (Division of Water Supply) also developed "Guidance on the Preparation of a Watershed Resource Protection Plan" (DEP, February 1990). The guidance document expands on the requirements contained in the policy; this Plan Update was prepared in accordance with the guidance document.

1.3.5 DEP Measures of Success

DEP has prepared a document titled "Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Suppliers to Obtain, and Maintain, a Waiver from Filtration Requirements, Draft #5" dated April 11, 1996. Referred to as the "Measures of Success," the document specifies DEP's process for assessing requests for filtration waivers and criteria–termed programmatic milestones–to measure the success of the water supplier's watershed efforts.

The "Measures of Success" identifies programmatic milestones organized into the following topics:

1. Watershed Control
2. Public Access/Recreation
3. Wildlife Management
4. Infrastructure Improvements
5. In-lake Problems
6. Sampling
7. System Operation/Maintenance
8. Staffing
9. Emergency Planning/Response
10. Education/Multi-town Coordination

To aid in comparing the Plan Update to the "Measures of Success," the matrix in Appendix A shows each programmatic milestone, the status of that milestone in the Quabbin Reservoir and Ware River watersheds, and references to relevant sections of this Plan.

1.3.5 DEP's "Developing a Local Surface Water Supply Protection Plan"

This document, prepared in July 1996, is intended to provide water suppliers with a low-cost method to develop a plan. The guidance is based on two maps and seven sections. Although this guidance does not apply to the more advanced DWM program, this Plan Update does contain the identified items.

1.3.6 DEP's Source Water Assessment Program (SWAP)

The Federal Safe Drinking Water Act Amendments of 1996 emphasize the importance of protecting public drinking water. The law requires every state to examine existing and potential threats to the quality of all its public water supply sources and to develop a Source Water Assessment Program (SWAP) during the next two years. DEP's SWAP process will: delineate protection areas for all public ground and surface water sources; inventory land uses in these areas that may present potential threats to water quality; determine the susceptibility of water supplies to contamination from these sources; and publicize the results. Source Water Assessments will help local and state officials target inspections and technical assistance where they are needed the most, encourage cooperative emergency response, and contribute to comprehensive protection of all public water sources. Information in the SWAP is also required in the MWRA's annual Consumer

Confidence Report (CCR). The first SWAP for the Quabbin Reservoir/Ware River System will be completed in 2001/2002.

1.3.7 EPA's Unfiltered Water Supply Systems Guidance Manual (Draft)

This draft manual supplements the existing SWTR guidance (1991) for unfiltered surface water supplies and identifies issues and requirements associated with the new IESWTR regulations. The document: 1) identifies provisions of the IESWTR impacting unfiltered surface water; 2) provides guidance on development of watershed control programs or enhancement of existing watershed control programs to address *Cryptosporidium*; and 3) provides information and guidance on monitoring for *Cryptosporidium*. The guidance document is based on a review of current literature and is supported by a review of watershed management programs developed by water utilities.

1.4 Scope of 2000 Plan Update

Watershed management has been ongoing in the Quabbin Reservoir watershed and Ware River watershed since the 1920's. MDC/DWM developed its comprehensive watershed protection program in 1991. Since the original plans' inception, the Division has been aggressively implementing and expanding its elements.

This Plan Update:

- Documents the recommendations of the 1991 Plan that have been completed;
- Incorporates the increased knowledge of the watersheds and water quality;
- Assesses the current "state of the watershed;"
- Formally states goals and five-year objectives for each program area; and
- Establishes a schedule of activities for the next five years.

The MDC/DWM's 1998 *Watershed Protection Plan Update for the Wachusett Reservoir Watershed* is unchanged by this document.

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Section 2
Watershed Assessment

Planning for management and control of a watershed must begin with an understanding of the natural processes and human development characteristics that influence how water flows throughout the landscape and affects its quality.

This section provides an overview assessment of watershed conditions. It is intended to give readers and reviewers a sense of the Quabbin Reservoir watershed and Ware River watershed, as well as act as a reference and guide to resource materials for DWM staff.

2.1 Natural Characteristics

Key Points

- DWM has delineated sanitary districts and smaller sub-districts within each watershed, and uses these sanitary sub-districts to organize and track watershed protection programs.
- The topography of the watersheds is mainly hilly, encompassing flatter wetlands and flood plains, as well as some mountainous terrain with exposed bedrock.
- Watershed geology features glacial till deposits on uplands and glacial outwash deposits on lowlands and valleys.
- Soils have low to moderate erosion potential, and because the watersheds are heavily forested and generally lack steep slopes, the extent of erosion prone areas is limited.
- Soils are generally not well suited for the disposal of wastewater through septic tanks, but strict Title 5 regulations set in place in 1995 are expected to prevent newer septic tanks from posing a threat to groundwater quality and to gradually replace or upgrade older substandard systems.
- Most of the Quabbin Reservoir watershed and Ware River watershed land is forested, and a large portion of the forested areas are owned by MDC/DWM or otherwise protected.

The natural characteristics of a watershed influence the hydrology and water quality of its streams and lakes/reservoirs. In addition, these characteristics should be considered when determining what watershed protection measures are appropriate to the watershed. Discussed in this section are sub-districts, sub-basins, and natural characteristics including topography, geology, soils, and vegetation.

2.1.1 Sub-districts

DWM has subdivided the Quabbin Reservoir and Ware River watersheds into 12 and 16 sanitary sub-districts, respectively (**Figures 2-1A & 2-1B**). The smaller sub-districts are manageable units for administrating watershed protection programs, identifying problems, and implementing solutions. DWM has also subdivided the Wachusett Reservoir watersheds into 48 smaller sub-basins.

2.1.2 Geology and Soils

Topography

Mainly hilly, the topography of the Quabbin Reservoir and Ware River watersheds encompasses flatter wetlands and flood plains, as well as some mountainous terrain with exposed bedrock. The Quabbin Reservoir watershed tends to have narrower valleys and steeper slopes, especially on its western side, where two ridgelines run from north to south.

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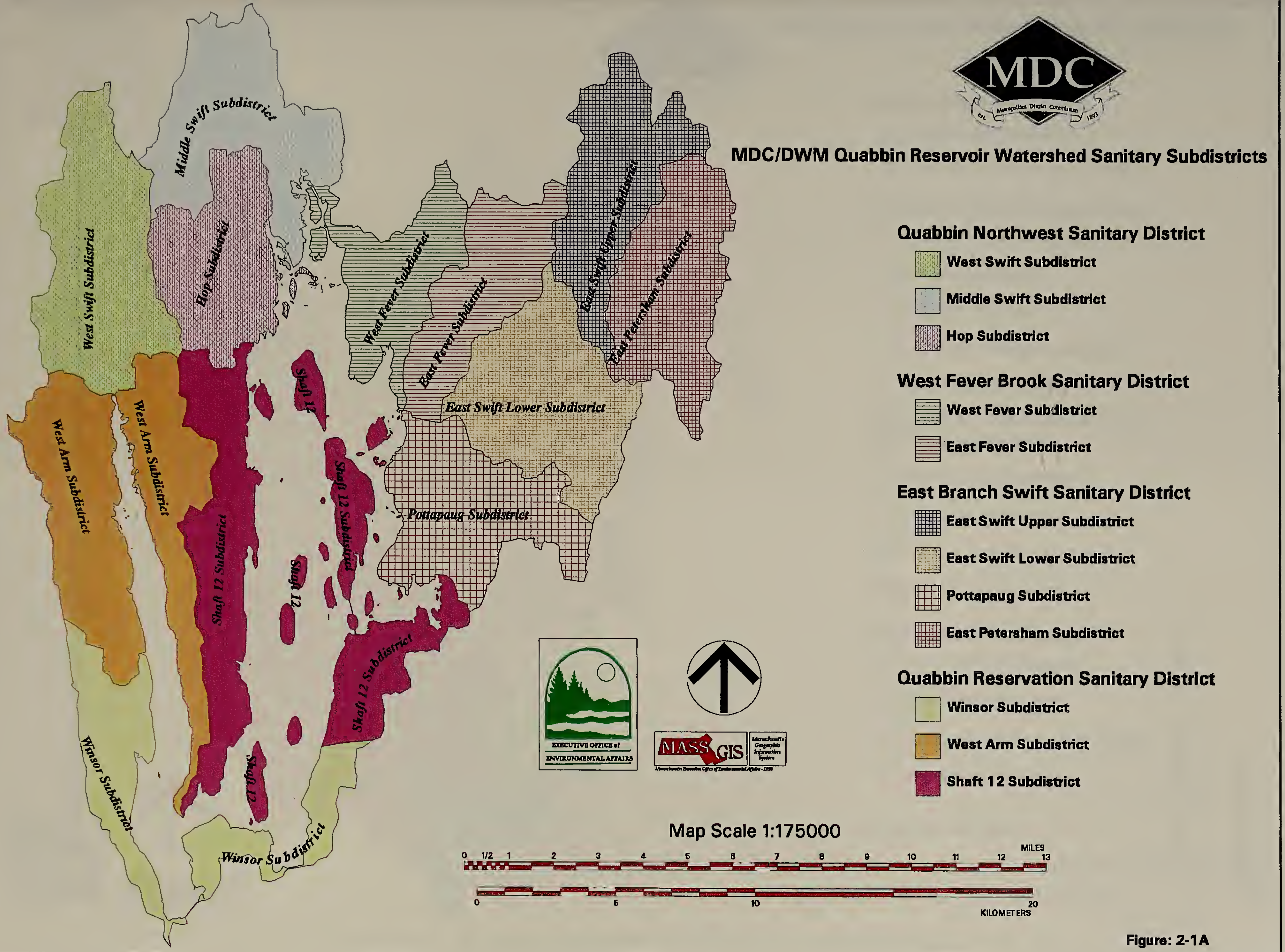
MDC/DWM Quabbin Reservoir Watershed Sanitary Subdistricts


MDC
Metropolitan District Commission
est. 1893
Quabbin Northwest Sanitary District
West Swift Subdistrict
Middle Swift Subdistrict
Hop Subdistrict
West Fever Brook Sanitary District
West Fever Subdistrict
East Fever Subdistrict
East Branch Swift Sanitary District
East Swift Upper Subdistrict
East Swift Lower Subdistrict
Pottapaug Subdistrict
East Petersham Subdistrict
Quabbin Reservation Sanitary District
Winsor Subdistrict
West Arm Subdistrict
Shaft 12 Subdistrict
Shaft 12
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MASS GIS
Map Scale 1:175000
0 1/2 1 2 3 4 5 6 7 8 9 10 11 12 13
MILES
0 5 10 20
KILOMETERS

Figure: 2-1A

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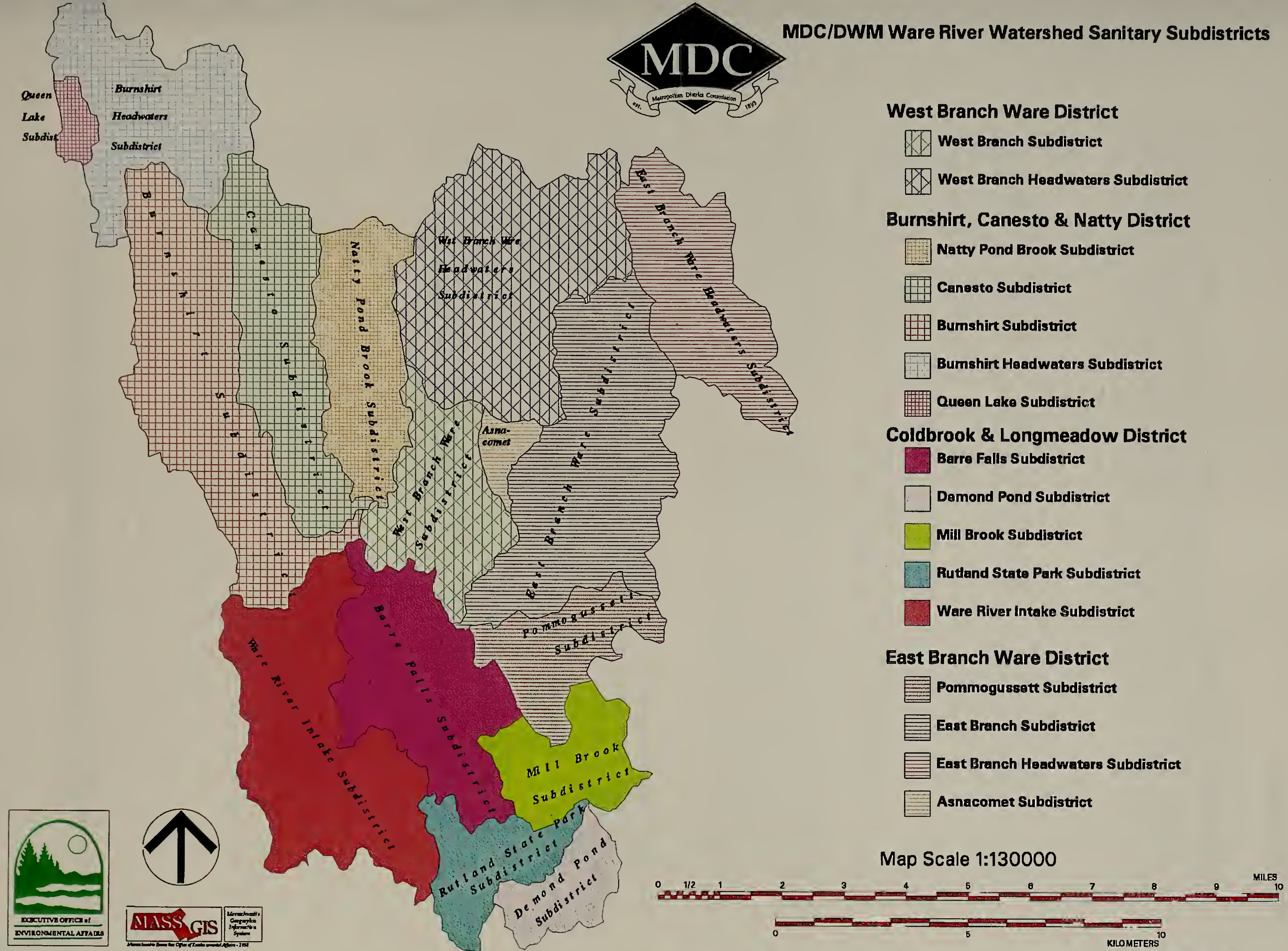
MDC/DWM Ware River Watershed Sanitary Subdistricts


MDC
Metropolitan District Commission
est. 1893
West Branch Ware District
West Branch Subdistrict
West Branch Headwaters Subdistrict
Burnshirt, Canesto & Natty District
Natty Pond Brook Subdistrict
Canesto Subdistrict
Burnshirt Subdistrict
Burnshirt Headwaters Subdistrict
Queen Lake Subdistrict
Coldbrook & Longmeadow District
Barre Falls Subdistrict
Demond Pond Subdistrict
Mill Brook Subdistrict
Rutland State Park Subdistrict
Ware River Intake Subdistrict
East Branch Ware District
Pommogussett Subdistrict
East Branch Subdistrict
East Branch Headwaters Subdistrict
Asnacomet Subdistrict
Map Scale 1:130000
0
1/2
1
2
3
4
5
6
7
8
9
10
MILES
0
5
10
KILOMETERS
Queen Lake Subdist
Burnshirt Headwaters Subdistrict
Burnshirt Subdistrict
Canesto Subdistrict
Natty Pond Brook Subdistrict
West Branch Ware Headwaters Subdistrict
East Branch Ware Headwaters Subdistrict
Asna-comet
West Branch Ware Subdistrict
East Branch Ware Subdistrict
Pommogussett Subdistrict
Ware River Intake Subdistrict
Barre Falls Subdistrict
Mill Brook Subdistrict
Rutland State Park Subdistrict
Demond Pond Subdistrict
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MASS GIS

Figure: 2-1B

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The Ware River watershed tends to have broader valleys and more wetlands. Elevations in the two watersheds vary from 530 feet above sea level at Quabbin Reservoir to about 2,000 feet at Wachusett Mountain (MDC, MWRA, and Rizzo Associates, 1991a; MDC, MWRA, and Rizzo Associates, 1991b). The Quabbin Reservoir and Ware River watersheds include scattered areas of steep slopes greater than 15%, which cover a combined total of approximately 18% of the watersheds.

Geology

The Quabbin Reservoir is located on the west flank of the eastern upland of south-central Massachusetts. This area is characterized by extensive preglacial erosion and weathering, which was followed by two major continental glaciations during the Pleistocene Epoch. The Pleistocene Epoch was the last glacial period and occurred about 12,000 years ago. The topography of the eastern part of the Quabbin Reservoir watershed is irregular with moderate slopes, while the western part is characterized by two, well defined, steeply sloped ranges oriented north and south through the length of the watershed. Elevations range from 530 feet (full reservoir elevation) to over 1,200 feet, with several hills exceeding this elevation (MDC, MWRA, and Rizzo Associates, 1991a). The topography is characterized by north to northeast trending hills and relatively narrow valley bottoms.

In comparison to the Quabbin Reservoir watershed, the topography of the Ware River watershed, located 15 miles to the east, is less hilly and has broader valley bottoms with extensive wetlands and floodplains underlain by thick stratified glaciofluvial and glaciolacustrine deposits. The Ware River watershed contains numerous drumlins that indicate the general direction of the glacial ice movement. The drumlins occur on upland hill crests and on the slopes of bedrock-controlled hills, exhibit a slightly west of north orientation, and are typically underlain by thick till sequences (MDC, MWRA, & Rizzo Associates, 1991b).

Most of the uplands in the Quabbin Reservoir watershed and Ware River watershed are covered with glacial till deposits several feet deep. Gravel till is the most extensive deposit in the Quabbin Reservoir watershed. Lowlands and valleys are usually filled with stratified glacial outwash deposits of silt, sand and gravel, and occasionally with swamp deposits of muck and peat. Depth to bedrock is variable–bedrock outcrops are commonly observed on the top and sides of hills, but bedrock also tends to be found at depths to 100 feet.

The bedrock geology consists of metamorphic and igneous bedrock units of the Connecticut Valley Belt lithotectonic subdivision. In general, the bedrock units are massive, resistant to weathering, and relatively impermeable. As a result, groundwater recharge into the bedrock is limited and rates of surface runoff to streams are comparatively high.

Soils

In the Quabbin Reservoir watershed, the predominant soils are Canton-Gloucester-Scituate. Other soils present include Hollis, Charlton, Woodbridge, Paxton, Ridgebury and Whitman. Many of these soils are moderately well drained to excessively well drained, including the Canton-Gloucester-Scituate, Hollis, and Paxton soils on uplands, and Charlton and Woodbridge soils on side slopes. These soils occur on nearly level to very steep areas and are very deep, except for Hollis soils, which are shallow. Other soils present are poorly drained, including the Ridgebury and Whitman soils on lower slopes and depressions (MDC, 1992a, 1993a, 1993b, and 1994c).

In the Ware River watershed, many soils have rapid permeability, including the Hinckley loamy sand and Colton gravel on valleys and wetlands. Other soils present have moderate to slow permeability, including many soils in hilltops and hillsides, or have very slow percolation rates, including the Bucksport and Wonsqueak mucks located in low wetland areas (MDC, 1992b, 1994d, 1994e and 1994f).

Septic Tank Suitability
According to the Natural Resources Conservation Service (formerly known as the USDA Soil Conservation Service), most soils in the Quabbin Reservoir and Ware River watersheds are not well suited for the disposal of wastewater through septic systems. Many soils that range from well drained to excessively well drained tend to drain effluent too quickly to effectively filter it. On the other hand, soils that are poorly drained are not well suited to contain septic tanks because they have slow permeabilities and water is usually present near the surface.

The unsuitability of soils, however, can be overcome through the careful design and siting of septic systems. Septic tanks that conform with Title 5 regulations, which were significantly revised in 1995, should not present a threat to the quality of groundwater, provided they are properly maintained. While most septic systems in the watershed predate the 1995 Title 5 regulations, the regulations require that substandard septic systems are gradually brought into compliance through inspections at the time of sale. In addition, state regulations require that systems that "fail" or cause surface breakouts must be repaired up to the standards by the Boards of Health. See **Section 6.3** for a detailed discussion of wastewater disposal.

2.1.3 Vegetation

Vegetative cover in the watersheds consists primarily of hardwood forest (i.e., deciduous trees such as maples, birches, ashes and oaks) and hardwood forest mixed with softwood forest (i.e., evergreen trees such as pines, hemlocks and spruces), and wetlands, with some scattered areas of cultivated land (corn, apples, hay). A large portion of the forested lands in the watershed are either owned by MDC/DWM or are otherwise protected (see **Section 2.2** and **Section 4** for more detail). MDC lands in the Quabbin Reservoir , Ware River, and Wachusett Reservoir watersheds were estimated to be about 65% hardwood forest, and about 30% softwood forest by Wallace, Floyd, Associates (1985). Other vegetation types were not significant. MDC has actively managed these lands for about 50 years, including thinning, cutting and planting for forest diversity and water quality.

2.2 Land Use and Land Cover

Key Points

- The two watersheds are sparsely developed, with most land cover consisting of forests and wetlands. 93% of the Quabbin Reservoir watershed's land cover is classified as forested or containing wetlands. In comparison, 86% of the land cover of the Ware River Watershed is forested or contains wetlands.
- 18% of the non-MDC/DWM owned watershed lands in the Quabbin Reservoir watershed are protected. 20% of the non-MDC/DWM owned land in the Ware River watershed are protected. Current development is lowest in the Quabbin Reservoir watershed and increases eastward to the Wachusett Reservoir watershed. The developed areas are classified primarily as low-density residential, with commercial and other developed land uses less significant. Areas of higher housing density and commercial activity tend to be located near the town centers and along major roads.
- Over the next 20 years, a moderate amount of development is expected in the Ware River watershed (based on 1998 report of the Wachusett Reservoir watershed by CDM). Due to past patterns, a lower amount of development is expected in the Quabbin Reservoir watershed. Most of this future development is expected to involve the gradual conversion of forested land into low-density residential land.
- Agricultural activity in the watersheds is limited. Most of the livestock farms in the watersheds tend to be small, with many "hobby" farms and horse stables, along with residential properties with horses (see **Section 6.2**).

Land use and development patterns in a watershed also influence the hydrology and water quality of its streams and lakes/reservoirs, and are important considerations to determine the appropriate protection measures for the watershed.

2.2.1 Current Land Cover and Land Use

Land cover, land use and population density for the Wachusett Reservoir, Quabbin Reservoir, and Ware River watersheds are shown in **Table 2-1** and a land use/land cover map is presented in **Figure 2-2**. The watershed system is sparsely developed. In general, the level of developed land is lowest in the Quabbin Reservoir watershed and increases eastward to the Wachusett Reservoir watershed. No wastewater treatment plants or industrial discharges exist within any of the three watersheds (MDC, MWRA and CDM, 1997).

Table 2-1

Land Cover, Land Use, and Population Density (1997)
MDC/DWM Active Watersheds

	Land Cover and Land Use (%) Excluding the Reservoirs							
Watershed	*Forest*	*Wetland*	*Agriculture*	*Residential*	*Commercial/ Industrial*	*Open Water*	*Other*	*Persons per sq. mi.*
Quabbin Reservoir	87	6	3	1	0.1	0.3	3	16
Ware River	75	11	5	3	0.2	3	4	77
Wachusett Reservoir	67	8	8	9	0.6	2	7	284
Total	**77**	**8**	**5**	**4**	**0.3**	**2**	**4**	**109**

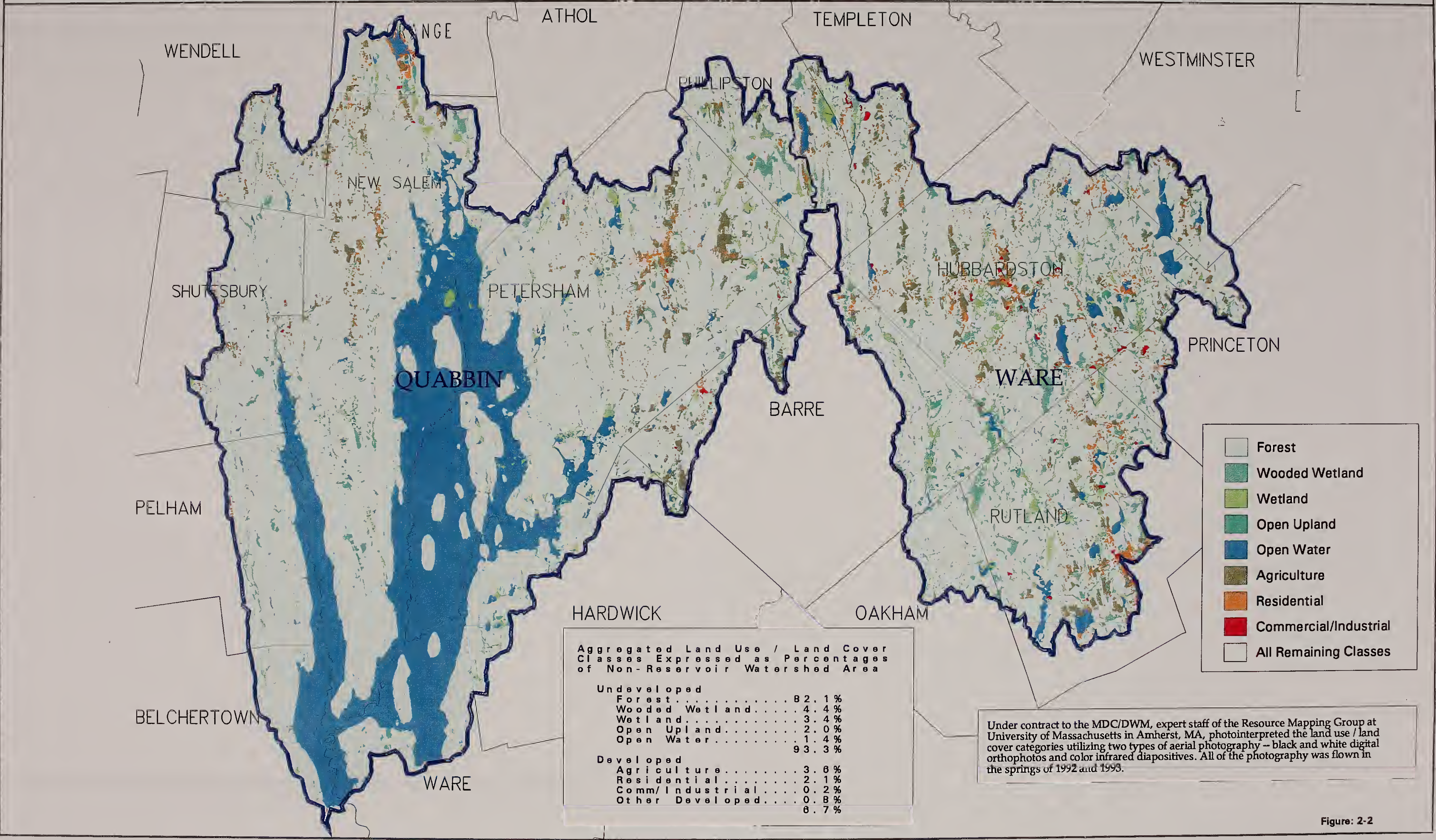
Source: (MDC, MWRA, and CDM, 1997)

The most common land cover in the MDC/DWM watersheds are forest cover and wetlands cover, totaling 93% in Quabbin Reservoir watershed, and 86% in Ware River watershed. The largest land uses are forestry, residential use, and agriculture. Residential land use is mostly low density and is more extensive in the Ware River watershed compared to the Quabbin Reservoir watershed. Housing density tends to be greater near the town centers. Commercial and other land uses (e.g., retail, highways, recreation, etc.,) are less significant in the watersheds.

In 1997, Comprehensive Environmental inventoried agricultural sites for DWM (CEI, 1997). These sites include dairy/ livestock farms (varying from several medium-size dairy farms to sites with two to ten animals), grazed land (pastures where livestock roam), and a variety of crop farms (orchards, truck crops, field crops, nurseries, Christmas tree farms). Collectively, most of the dairy/livestock farms in the watersheds tend to be small, with many "hobby" farms and residential properties with horses. **Section 6.2** presents a full description of agriculture in the Quabbin Reservoir watershed and Ware River watershed.

Land Use / Land Cover Classifications

Aggregated into Major Categories


Statute Miles
0
1
2
3
4
5
6
7
8
9
10
WENDELL
ORANGE
ATHOL
TEMPLETON
WESTMINSTER
PHILLIPSTON
NEW SALEM
SHUTESBURY
PETERSHAM
HUBBARDSTON
PRINCETON
QUABBIN
WARE
BARRE
PELHAM
RUTLAND
HARDWICK
OAKHAM
BELCHERTOWN
WARE
Forest
Wooded Wetland
Wetland
Open Upland
Open Water
Agriculture
Residential
Commercial/Industrial
All Remaining Classes

Aggregated Land Use / Land Cover Classes Expressed as Percentages of Non-Reservoir Watershed Area

Undeveloped	
Forest	82.1%
Wooded Wetland	4.4%
Wetland	3.4%
Open Upland	2.0%
Open Water	1.4%
	93.3%
Developed	
Agriculture	3.6%
Residential	2.1%
Comm/Industrial	0.2%
Other Developed	0.8%
	6.7%

Under contract to the MDC/DWM, expert staff of the Resource Mapping Group at University of Massachusetts in Amherst, MA, photointerpreted the land use / land cover categories utilizing two types of aerial photography -- black and white digital orthophotos and color infrared diapositives. All of the photography was flown in the springs of 1992 and 1993.

Figure: 2-2

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2.2.2 Protected Lands

Overall, the MDC/DWM owns and/or directly controls about 42% of the entire watershed system, exclusive of the reservoirs themselves. MDC/DWM owns approximately 57% of the Quabbin Reservoir watershed, 37% of the Ware River watershed and 26% of the Wachusett Reservoir watershed (presented in **Table 2-2**) and controls additional critical areas under the Watershed Protection Act (WsPA) in all three watersheds. Other state agencies, non-profit land conservation organizations, and municipalities own and protect another 21% of the combined watersheds. **Figure 2-3** shows the MDC/DWM drinking water supply land and other protected lands in the watersheds. See **Section 4** for more details regarding protected lands.

Table 2-2

MDC/DWM Water Supply Lands and Protected Open Space (1999)

	Ownership as % of Watershed - 1999*			
MDC/DWM Watershed	***MDC/DWM - Owned***	***Other Protected*****	***Total Protected***	***Total Protected and WsPA Regulated***
Quabbin Reservoir	57	18	75	83
Ware River	37	20	57	70
Wachusett Reservoir	26	26	52	69
Total	**42**	**21**	**63**	**75**

Source: (MDC/DWM-GIS, 2000)
* Watershed area excluding reservoir surface.
** Includes lands owned by other state agencies, local government, and private entities; excludes Ch. 61 and Stewardship lands.

2.2.3 Development

The Quabbin Reservoir and Ware River watersheds are mostly undeveloped, with much of the forests and wetlands either owned by MDC/DWM for water supply protection or other state agencies for a variety of functions. Forested land which is currently not owned by MDC/DWM or preserved by state/local governments or by private entities (approximately 15% of the Quabbin Reservoir watershed, and 23% of the Ware River watershed), and is either open field or agricultural land (3-8% of the watersheds) could be developed in the future for residential, commercial, industrial or other land uses if permitted by zoning laws. The cumulative amount of development that is expected in the watersheds is much lower than the current amount of available "unprotected" land. The rate of development depends on many social and economic factors, including development pressure, the need or willingness of current owners to sell their land, and population growth.

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MDC/DWM Holdings and Other Protected Open Space

Reflecting MDC/DWM Acquisitions Through January, 2000

Statute Miles
0 1 2 3 4 5 6 7 8 9 10

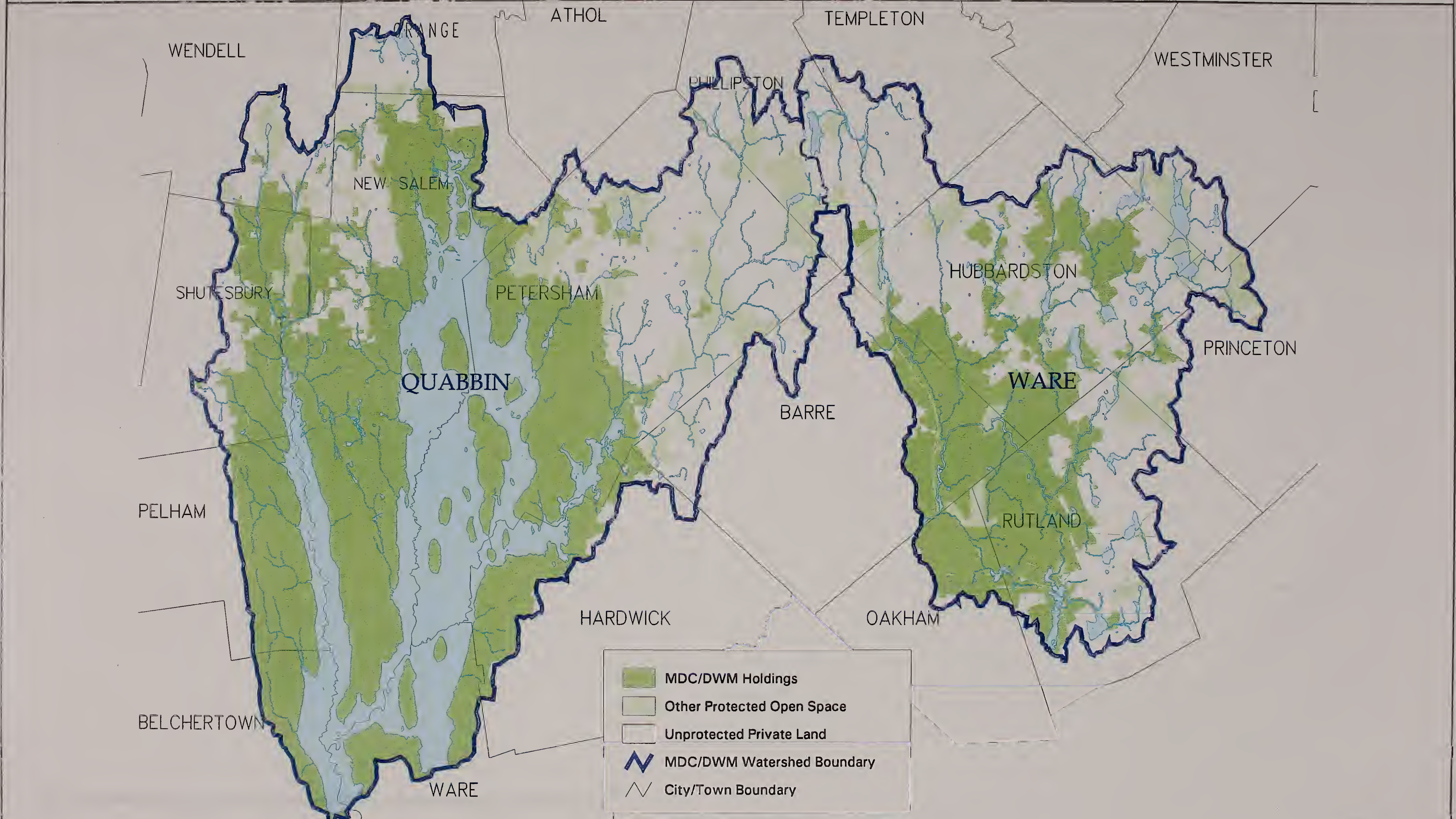
WENDELL
ORANGE
ATHOL
TEMPLETON
WESTMINSTER
PHILLIPSTON
NEW SALEM
SHUTESBURY
PETERSHAM
HUBBARDSTON
QUABBIN
WARE
PRINCETON
BARRE
PELHAM
RUTLAND
HARDWICK
OAKHAM
BELCHERTOWN
WARE
🟩 MDC/DWM Holdings
🟩 Other Protected Open Space
☐ Unprotected Private Land
MDC/DWM Watershed Boundary
City/Town Boundary

Figure: 2-3

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2.3 Hydrology

Key Points

- The average annual precipitation at the Quabbin Reservoir over the past seventy years is 46 inches precipitation/year. The average reservoir gain or yield from 1 inch of precipitation is approximately 1.6 billion gallons.
- Streamflows in the Quabbin Reservoir and Ware River watersheds have significant seasonal variations. Flows tend to be highest in the spring, due to snowmelt and high groundwater levels and lower in the summer and early fall. Streamflow also varies in response to rainfall events, being several times higher than baseflow during storms.
- On an annual basis, Quabbin Reservoir receives most of its inflow from direct precipitation (about 30%), but also gets significant water inputs from direct inflow, the East Branch of the Swift River, and Ware River transfers. Quabbin Reservoir's diversion provides approximately 50% of Wachusett Reservoir's inflow.
- The reservoir's elongated shape and large size results in long detention times, and significant dilution and settling of tributary inflows. The Quabbin Reservoir's length is 18 miles. The reservoir has an average depth of 45 feet, maximum depth of 151', and capacity of 412 billion gallons of water. When the reservoir is full, the reservoir elevation is 530' (Boston City Base).
- The reservoir is subject to seasonal effects, turning over and mixing completely in the late fall and spring, and developing some ice cover in the winter. Inflows from streams move at different depths depending on the temperature difference between tributary and reservoir water.
- Recent research has identified the importance of wind driven phenomena and the occurrence of both lateral and vertical circulation patterns in the Quabbin Reservoir's Winsor Dam basin.

The hydrology of a watershed plays an important role in defining the water quality characteristics of its streams and lakes/reservoirs. The following sections describe the morphology of the reservoir; the precipitation, evaporation, and streamflow patterns in the Quabbin Reservoir and Ware River watersheds; and the inflows and outflows and hydrodynamic characteristics of the Quabbin Reservoir.

Figure 2-4 shows the Quabbin and Wachusett Reservoirs, their watersheds, and the Ware River watershed. The Quabbin and Wachusett Reservoirs receive the natural inflows of direct precipitation onto the water surface, tributary rivers and streams (including baseflow and runoff components) and stormwater runoff or snowmelt from drainage areas around the shoreline. The Ware River is diverted on a seasonal basis to Quabbin Reservoir through the Quabbin Aqueduct. Transfers from the Quabbin Reservoir through the Quabbin Aqueduct provide the Wachusett Reservoir, a terminal water supply reservoir, with more than 50% of its annual inflow. **Figures 2-5A & 2-5B** show hydrological features of Quabbin Reservoir and Ware River watersheds, respectively. These features include tributaries, ponds/lakes, and the larger wetlands.

The Quabbin Reservoir is located in the valley of the impounded Swift River, a tributary to the Connecticut River, and has a watershed area of 119,940 acres including the reservoir surface area. The Ware River watershed has an area of 61,600 acres.

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MDC/DWM Active Water Supply Watersheds Base Map

Quabbin Reservoir, Ware River and Wachusett Reservoir Watersheds

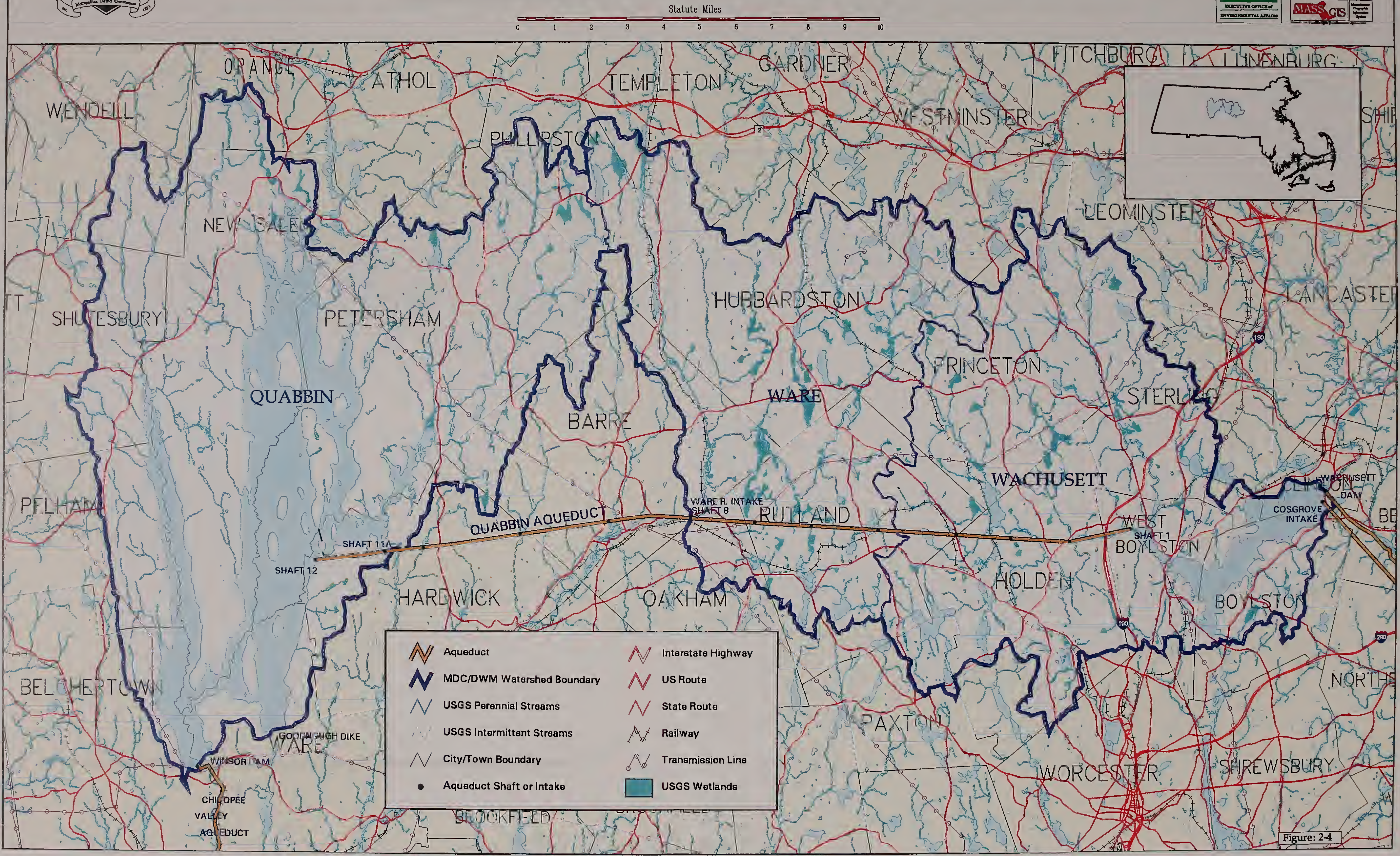
Statute Miles
0 1 2 3 4 5 6 7 8 9 10
ORANGE
ATHOL
TEMPLETON
GARDNER
FITCHBURG
LUNENBURG
WENDELL
PHILLIPSTON
WESTMINSTER
NEW SALEM
LEOMINSTER
SHUTESBURY
PETERSHAM
HUBBARDSTON
LANCASTER
QUABBIN
PRINCETON
WARE
STERLING
BARRE
WACHUSETT
WACHUSETT DAM
CLINTON
PELHAM
WARE R. INTAKE SHAFT 8
RUTLAND
COSGROVE INTAKE
QUABBIN AQUEDUCT
WEST BOYLSTON
SHAFT 1
SHAFT 11A
SHAFT 12
HARDWICK
OAKHAM
HOLDEN
BOYLSTON
BELCHERTOWN
NORTHBOROUGH
GOODNOUGH DIKE
PAXTON
WARE
WINSOR DAM
WORCESTER
SHREWSBURY
CHICOPEE VALLEY AQUEDUCT
BROOKFIELD
190
290
Aqueduct
MDC/DWM Watershed Boundary
USGS Perennial Streams
USGS Intermittent Streams
City/Town Boundary
● Aqueduct Shaft or Intake
Interstate Highway
US Route
State Route
Railway
Transmission Line
USGS Wetlands

Figure: 2-4

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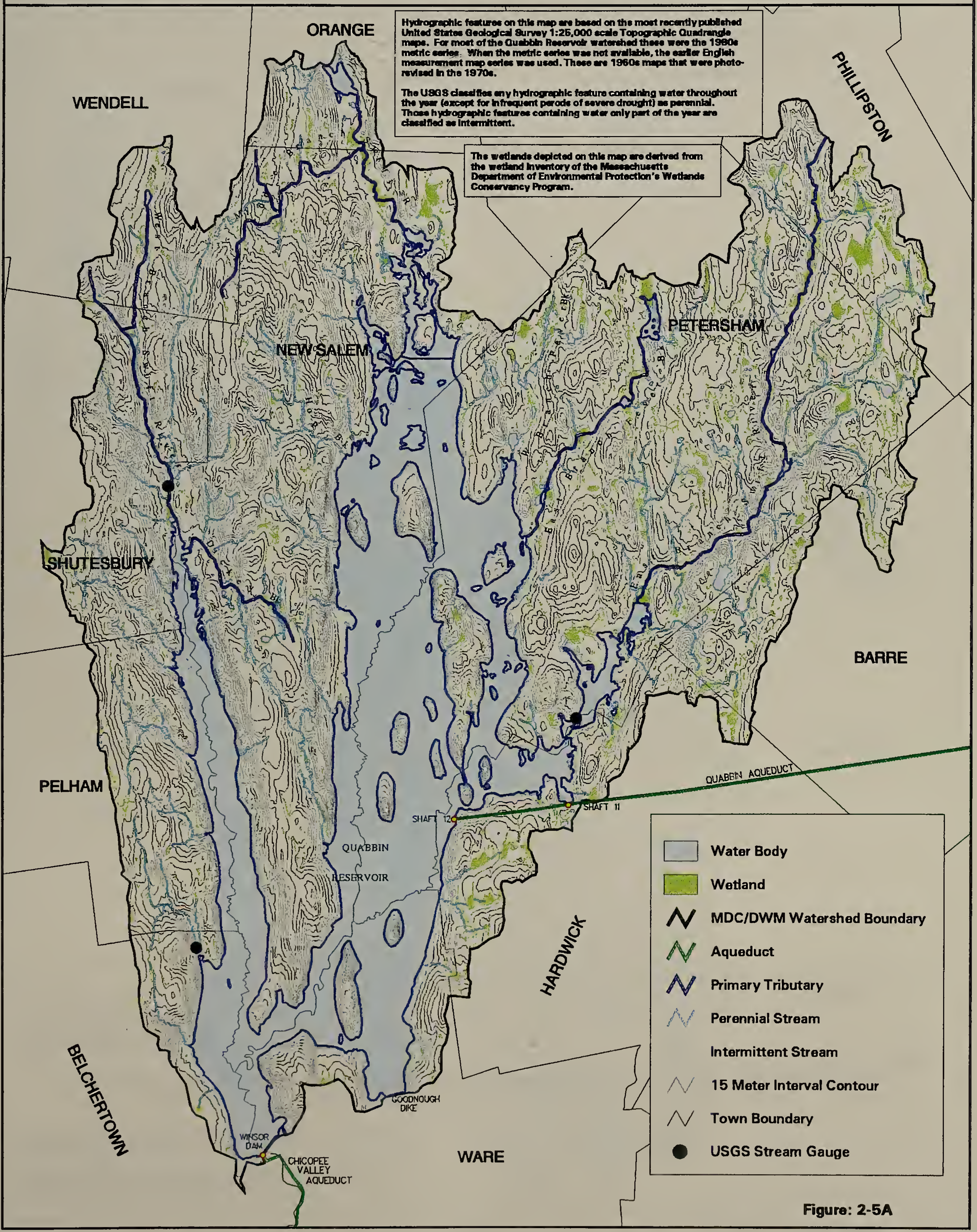
Major Hydrographic Features

Quabbin Reservoir Watershed

Statute Miles

0 1 2 3 4 5



Hydrographic features on this map are based on the most recently published United States Geological Survey 1:25,000 scale Topographic Quadrangle maps. For most of the Quabbin Reservoir watershed these were the 1980s metric series. When the metric series was not available, the earlier English measurement map series was used. These are 1960s maps that were photo-revised in the 1970s.

The USGS classifies any hydrographic feature containing water throughout the year (except for infrequent perods of severe drought) as perennial. Those hydrographic features containing water only part of the year are classified as intermittent.

The wetlands depicted on this map are derived from the wetland inventory of the Massachusetts Department of Environmental Protection's Wetlands Conservancy Program.

ORANGE
WENDELL
PHILLIPSTON
NEW SALEM
PETERSHAM
SHUTESBURY
BARRE
PELHAM
QUABBIN AQUEDUCT
SHAFT 11
SHAFT 12
QUABBIN RESERVOIR
HARDWICK
BELCHERTOWN
GOODNOUGH DIKE
WINSOR DAM
CHICOPEE VALLEY AQUEDUCT
WARE
Water Body
Wetland
MDC/DWM Watershed Boundary
Aqueduct
Primary Tributary
Perennial Stream
Intermittent Stream
15 Meter Interval Contour
Town Boundary
USGS Stream Gauge

Figure: 2-5A

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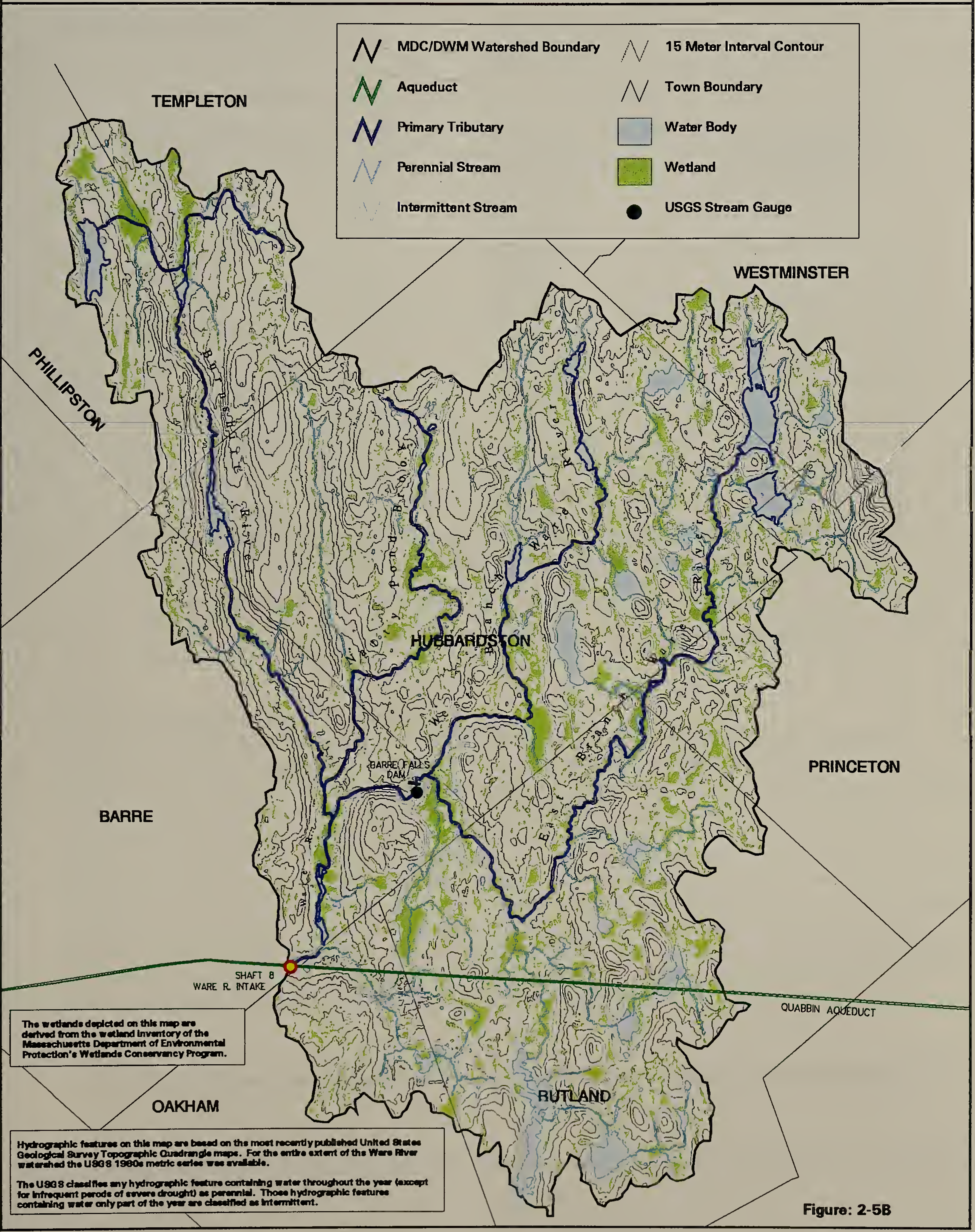
Major Hydrographic Features

Ware River Watershed


Statute Miles
0 1 2 3 4 5
MDC/DWM Watershed Boundary
Aqueduct
Primary Tributary
Perennial Stream
Intermittent Stream
15 Meter Interval Contour
Town Boundary
Water Body
Wetland
USGS Stream Gauge
TEMPLETON
PHILLIPSTON
WESTMINSTER
HUBBARDSTON
BARRE FALLS DAM
BARRE
PRINCETON
SHAFT 8
WARE R. INTAKE
QUABBIN AQUEDUCT
OAKHAM
RUTLAND

The wetlands depicted on this map are derived from the wetland inventory of the Massachusetts Department of Environmental Protection's Wetlands Conservancy Program.

Hydrographic features on this map are based on the most recently published United States Geological Survey Topographic Quadrangle maps. For the entire extent of the Ware River watershed the USGS 1980s metric series was available.

The USGS classifies any hydrographic feature containing water throughout the year (except for infrequent periods of severe drought) as perennial. Those hydrographic features containing water only part of the year are classified as intermittent.

Figure: 2-5B

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2.3.1 Morphology

The Quabbin Reservoir is a long reservoir with two main longitudinal sections linked by a narrow channel, the Enfield Channel. Morphometric characteristics comparing the Quabbin Reservoir with the Wachusett Reservoir are presented in **Table 2-3.**

Table 2-3

Morphology of Quabbin Reservoir and Wachusett Reservoir

Attribute	*Quabbin Reservoir*	*Wachusett Reservoir*
Volume Capacity	412 billion gallons	65 billion gallons
Surface Area	39.4 square miles	6.5 square miles
Watershed Area	187 square miles	107.69 square miles
Shoreline	118 miles	37 miles
Length	18 miles	8.5 miles
Maximum Width	3 miles	1.1 miles
Mean Width	1.5 miles	0.7 miles
Maximum Depth	151 feet	128 feet
Mean Depth	45 feet	49 feet
Normal Operation Range	520-530 feet	387-392 feet
Intake Depth[2]	442 feet[1]	364 & 345 feet
Overflow Elevation[3]	530 feet	395 feet

Source: (MDC/DWM – Civil Engineers Records, 2000)

[1] Intake for Quabbin Reservoir is for Quabbin Aqueduct. This is the elevation between the portal invert and the shaft floor.

[2] Datum used is Boston City Base (BCB) which is 6.049 feet lower than USGS 1929 datum used for topographic mapping.

[3] When stop logs are in place the overflow elevation is 530 feet. When the logs are removed the elevation is 528 feet.

2.3.2 Precipitation and Evaporation

The Quabbin Reservoir and Ware River watersheds are located in central Massachusetts within the same climate zone and their precipitation and evaporation patterns are fairly similar. Monthly rainfall in the Quabbin Reservoir and Ware River watersheds is nearly uniform, although it can vary significantly from year to year. Summer precipitation generally comes in high-intensity thunderstorms. **Table 2-4** presents the annual values and averages of annual precipitation recorded at the Quabbin Reservoir and the Ware River Intake between 1930-1999. The average annual precipitation at the Quabbin Reservoir station has been 46" and 44" at the Ware River Intake (a.k.a., Lonergan Intake). The MDC has maintained one weather station at the Quabbin Reservoir and the MWRA currently maintains a weather station at the Ware River intake. Based on readings from these stations, the minimum annual precipitation measurements taken between 1930 and 1999 was recorded in 1965. The minimum reading at the Quabbin station was 29.70" and 28.73" at the Ware River station. During this same time period, the maximum annual precipitation was recorded in 1938 with 66.41" at the Quabbin Reservoir station and 61.25" at the Ware River station.

Table 2-4

Annual Precipitation at Quabbin Reservoir and Ware River stations 1930-1999

Year	*Quabbin Reservoir station Belchertown (Enfield)*	*Ware River station Lonergan Intake (Coldbrook)*
1930	39.36	32.83
1931	45.30	40.55
1932	41.43	41.19
1933	53.48	42.26
1934	49.64	45.89
1935	38.15	35.65
1936	55.24	56.26
1937	55.71	48.08
1938	66.41 (max.)	61.25 (max.)
1939	38.37	33.06
1940	40.48	39.91
1941	32.66	29.39
1942	47.55	46.96
1943	43.99	38.33
1944	42.40	40.75
1945	50.71	48.25
1946	38.43	42.14
1947	39.42	36.56
1948	45.25	50.03
1949	37.40	36.00
1950	41.30	43.89
1951	49.73	56.01
1952	45.19	42.66
1953	51.52	50.86
1954	49.03	52.75
1955	64.92	55.92
1956	46.57	45.49
1957	36.32	37.73
1958	49.47	47.17
1959	54.25	51.10
1960	50.57	49.11
1961	41.75	44.07
1962	38.14	40.79
1963	41.64	36.93
1964	31.57	33.00
1965	29.7 (min.)	28.73 (min.)
1966	36.66	36.86
1967	44.89	45.24
1968	40.47	37.52
1969	44.58	43.07
1970	41.95	40.94
1971	44.58	37.57
1972	57.88	56.42
1973	50.24	46.78
1974	49.43	44.41
1975	58.98	53.54
1976	46.19	39.71
1977	52.01	47.95
1978	43.55	38.33
1979	58.59	56.18
1980	32.41	35.92
1981	42.99	44.58
1982	48.09	46.42
1983	57.41	52.58
1984	49.92	44.99
1985	45.93	37.35
1986	44.2	40.27
1987	40.38	39.12
1988	43.42	38.54
1989	58.02	49.33
1990	53.10	50.43
1991	51.72	48.42
1992	41.63	39.97
1993	43.5	41.60
1994	50.85	44.83
1995	44.98	38.22
1996	60.43	58.54
1997	43.8	37.52
1998	43.38	39.89
1999	48.11	44.06
Average	***46.25***	***43.70***

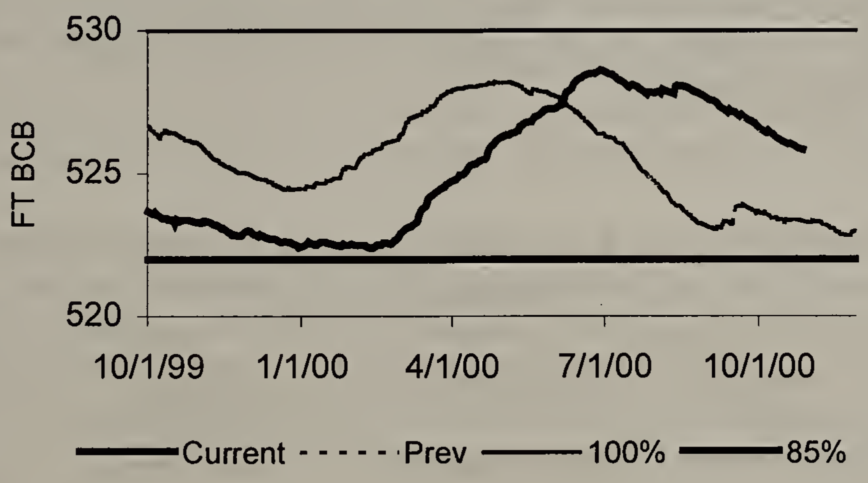
Source: (MDC/DWM – CE Records 2000)
Note - diversions are not indicated.

Annual evapotranspiration in central Massachusetts has been estimated between 22 and 28 inches (Thornthwaite *et. al.*, 1958). While evaporation measured with an evaporation pan is about 39 inches in Massachusetts (Higgins, 1968), evaporation in lakes and reservoirs is usually lower. Annual evaporation on Quabbin Reservoir has been estimated as 22 inches.

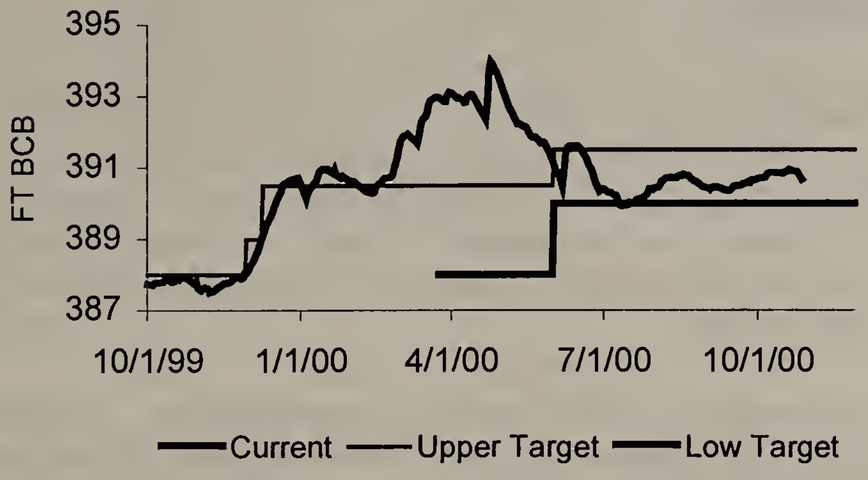
Figure 2-6 illustrates the daily elevations at the Quabbin Reservoir and Wachusett Reservoir. Spring events contribute most to the reservoir's recharge. Water use and evaporation are highest the during summer months (seen by the decrease in reservoir level).

Figure 2-6

Quabbin Reservoir Daily Elevation



Wachusett Reservoir Daily Elevation



1999/2000 Elevations: Quabbin Reservoir and Wachusett Reservoir

Source: (MWRA, 2000)

Snow Survey – Quabbin Reservoir Watershed
Since the 1930's, MDC has conducted a snow survey in the Quabbin Reservoir watershed. The purpose of the survey is to record the potential rise in reservoir elevation (potential inflow) as well as the flood potential of rivers and streams due to snowmelt. Prior to the filling of the Quabbin Reservoir, MDC monitored twelve snow survey stations in the Quabbin Reservoir watershed. Once the reservoir was filled, six of the twelve stations remained. DWM staff monitors six snow survey stations weekly, typically between January and April. DWM staff take six samples at each station location using a snow density gage to measure snow depth and weight. The average depth and weight measurements are used to determine the average water content of the snow pack. Staff report average depth and water conversion figures to both the Division, as "potential rise in reservoir elevation" and to DEM's Division of Resource Conservation, as river and stream flood potential. Over the past twenty-two years, the average annual snow depth at the six stations within the Quabbin Reservoir watershed has been 47.47" (MDC/DWM-CE, 2000).

Snow Survey – Ware River Watershed
MDC monitored seven snow survey stations in the Ware River watershed until the 1970's. Then, the MDC increased the number of stations and monitored nine snow survey stations in the watershed until the MWRA took over these duties in the late 1980's. In 1995, MWRA discontinued the snow survey in the Ware River watershed because of personnel changes.

2.3.3 Streamflow

Streamflow in the Quabbin Reservoir and Ware River watersheds, as in most of New England, has significant seasonal changes. Flows tend to be highest in the spring, due to snowmelt and high groundwater; and lower in the summer and early fall due to greater solar radiation and evapotranspiration. These seasonal changes are important since "high flow" water quality threats (streambank erosion) tend to occur in the spring, whereas "low flow" water quality threats due to lower dilution (higher bacteria levels) tend to occur in the summer and early fall. Streamflow varies within and between watersheds (see **Table 2.5**) .

DWM staff monitor stream flow at selected sites where water quality samples are taken (see **Section 8.1**) in both the Quabbin Reservoir and Ware River watersheds.

2.3.4 Inflows and Outflows

Quabbin Reservoir
Inflows and outflows to Quabbin Reservoir are listed in **Table 2-6**. There are currently two continuous stream gauging locations within the Quabbin Reservoir watershed: the East Branch of the Swift River (1937-present); and the West Branch of the Swift River (1995-present). There is also a long stream gauging record at Cadwell Creek (1961-1997), which was discontinued in 1997. Tributary inflows were estimated for this assessment by doing a stream gauge transposition using the flows recorded by the gauges at the East Branch of the Swift River and Cadwell Creek.

Direct precipitation accounts for almost 30% of the average annual inflow. Inflows from Quabbin Reservoir's main tributary, the East Branch of the Swift River and direct inflow follow direct precipitation in magnitude and, combined, account for about 34% of the annual inflow (on a long-term basis). Ware River transfers are also a significant source of inflow, at about 9% of the annual inflow.

The largest outflow from Quabbin Reservoir is the Quabbin Aqueduct withdrawal for transfer into Wachusett Reservoir, which accounts for more than 60% of water that leaves the reservoir. Other significant outflows are evaporation and downstream release to the Swift River, which together account for almost another 30% of the outgoing water. Other smaller outflows include Chicopee Valley Aqueduct withdrawals for the Chicopee Valley Service Area and the flow over the reservoir's spill way, which occur when the reservoir is full or almost full. In 1999, water transfers to the City of Worcester were additional outflows from the system. The estimated loss through the Winsor Dam and Goodnough Dike is currently under review.

Ware River Watershed

MDC/DWM and MWRA may divert water from the Ware River watershed at the Ware River Intake (a.k.a., Shaft 8) either to the Quabbin Reservoir or the Wachusett Reservoir through the Quabbin Aqueduct. The water enters the system at Shaft 8 on the Quabbin Aqueduct in the town of Barre, Massachusetts. Under normal operating conditions, the Ware River water flows to the Quabbin Reservoir through the aqueduct and is discharged at Shaft 11A, where the baffle dams (see **Figure 2-4**) force the water to flow several miles to reach Shaft 12 of the Aqueduct or further to the Chicopee Valley Aqueduct. It takes several years (3-4 years) for water entering the Reservoir at Shaft 11A to travel to Shaft 12. In the past twenty-five years, there have been twenty-one annual diversions directly from the intake to the Wachusett Reservoir, and eighteen annual diversions directly to the Quabbin Reservoir (MDC/DWM-CE, 2000) from the Ware River intake. Ware River water can only be diverted to the aqueduct if the flow is in excess of 85 million gallons a day and if the diversion is during a certain time period, as authorized under Chapter 375 of the Acts of 1926. The diversion, limited by Massachusetts legislation, may occur between the period from December 1 to June 1 and may include the period of October 15 to June 15, if necessary (Special Report, 1931) (**Table 2-6**).

Table 2-5

Stream Flow Data For Selected Tributaries

in the Quabbin Reservoir Watershed and Ware River Watershed

	1996 Data					
Station Name (number)	*Drainage Area (miles^2)*	*Datum (ft above NGVD)*	*Total Discharge (cfs)*	*Mean Daily Discharge (cfs)*	*Maximum Daily Discharge (cfs)*	*Minimum Daily Discharge (cfs)*
Ware River Near Barre, MA (01172800)	55.1	745	57,720	158	1,240	1.5
Ware River At Intake Works Near Barre, MA (01172500)	96.3	632	102,105	279	1,310	12
East Branch Swift River Near Hardwick, MA (01174500)	43.7	504.7	49,296.8	135	985	9.8
West Branch Swift River Near Shutesbury, MA (01174565)	12.6	500	13,712.0	37.5	377	1.2
Cadwell Creek Near Belchertown, MA (01174900)	2.55	NA	3,242.51	8.86	80	0.21

Source: (USGS-MA, 2000)

Table 2-6

Inflows to and Outflows from Quabbin Reservoir

	Area (sq. mi.)[1]	*Annual Flow (cfs)*[2]	*Annual Flow (mgd)*[2]	*Annual Flow (%)*
Inflows:				
Direct Precipitation	38	125	81	28
Ware River Transfers	96	39	25	9
Direct Inflow	40	78	51	17
East Branch Swift River	44	75	49	17
West Branch Swift River	12	24	16	5
Middle Branch Swift	11	21	14	5
East Branch Fever Brook	9	17	11	4
West Branch Fever Brook	5	9	6	2
Hop Brook	5	11	7	2
Dickey Brook	4	8	5	2
Other tributaries	20	40	26	9
Outflows:				
Quabbin Aqueduct	NA	238	154	63
Chicopee Valley Aqueducts	NA	18	12	5
Evaporation	38	68	44	18
Downstream Release	NA	42	27	11
Spillway	NA	9	6	2

[1] Areas obtained from MDC, MWRA, and Rizzo Associates (1991a).

[2] Tributary inflows were estimated for this assessment by gage transposition using the USGS gauged records for the East Branch of the Swift River and Cadwell Creek. Ware River transfers and outflows were obtained from MDC records. Evaporation was estimated at 24.5 in/yr using the results of the 1995 modeling study for Wachusett Reservoir (CDM, 1995b).

Currently, water transfers from the Quabbin Reservoir account for over 50% of the average annual Wachusett Reservoir's inflow. Transfers of approximately 550 mgd are made as needed to maintain the Wachusett Reservoir surface levels. These transfers, which occur primarily in the summer and fall months, are not continuous and last for a period of several weeks at a time. Annual diversions from the Ware River to the Quabbin Reservoir and Wachusett Reservoir over the past twenty-five years are summarized in **Table 2-7**. These diversions may occur during a specific time period under specific flow conditions in the Ware River.

Table 2-7

Annual MDC/DWM Diversions Yearly Totals - Ware River Transfers

1973-1998

Year	*To Ware River, below Intake (MG)*	*To Quabbin Reservoir (MG)*	*To Wachusett Reservoir (MG)*	*Total Flow (MG)*
1973	24,774.40	28,619.50	631.6	54,025.50
1974	25,049.10	14,396.20	1,590.20	41,035.50
1975	30,191.10	21,636.80	103.8	51,931.70
1976	29,516.30	5,259.90	840.4	35,616.60
1977	24,566.50	20,683.50	1,024.10	46,274.10
1978	25,964.30	11,223.10	102.6	37,290.00
1979	38,911.60	19,008.30	2,100.60	60,020.50
1980	17,731.40	11,378.30	85.8	29,195.50
1981	24,390.40	10,401.40	2,383.90	37,175.70
1982	27,025.00	22,072.30	1,191.80	50,289.10
1983	32,708.10	21,940.80	802.6	55,451.50
1984	40,724.80	9,887.00	376.2	50,988.00
1985	22468.9	3,385.30	1,218.60	27,072.80
1986	23,465.10	16,315.60	644.5	40,425.20
1987	22,064.50	15,942.00	2,910.80	40,917.30
1988	22,231.00	8,086.60	1,071.30	31,388.90
1989	27,523.40	19,395.40	53.1	46,971.90
1990	25,591.70	20,803.50	1,272.60	47,667.80
1991	30,012.80	14,273.70	2,461.20	46,747.70
1992	31,560.80	0	0	31,560.80
1993	37,813.00	3,693.70	0	41,506.70
1994	41,924.50	0	0	41,924.50
1995	32,718.70	230	7.3	32,956.00
1996	63,606.70	2,383.80	0	65,990.50
1997	36,387.80	0	0	36,387.80
1998	41,904.80	2,708.90	0	44,613.70

Source: (Data taken from the Lonergan Intake by MWRA and submitted to MDC/DWM–CE, 2000)

2.3.5 Hydrodynamics

Quabbin Reservoir and Wachusett Reservoir share a number of basic hydrodynamic characteristics:

- They have moderate to long residence times, defined as the reservoir volume divided by the annual inflows. For Quabbin Reservoir, the average residence time is about 4 years; for Wachusett Reservoir, it is about 6 months, but would double to about one year if Quabbin flows were not diverted into the reservoir.
- They are both dimictic, turning over or mixing completely at fall overturn (usually in October), and again in spring in the period, immediately following ice-out (usually in April).
- They both develop some ice cover, usually between January and March, but occurring as early as December or as late as April.
- Their inflows tend to move into different depths of the reservoirs depending on seasonal temperature differences between the tributaries and the reservoirs. Tributary inflows will typically be warmer than the reservoirs in the spring and enter the reservoirs' epilimnion[1], and cooler than the reservoirs in the summer and fall and enter the reservoirs below the epilimnion. MDC/DWM transfers of water from the Quabbin Reservoir into Wachusett Reservoir typically enter at the top of the hypolimnion.

Quabbin Reservoir

The hydrodynamics of the Quabbin Reservoir is the subject of an extensive study by UMass – Amherst Department of Civil and Environmental Engineering (UMass, 1996; UMass, 1998) These studies have some important results:

- Investigation of reservoir currents and dispersion suggest that surface speed in Winsor Dam Basin (Quabbin Reservoir) is approximately 4% of the wind speed. In the same 1998 study, both lateral and vertical circulation patterns were identified in the basin (UMass 1998).
- Sampling and statistical analysis of coliform bacteria decay that is associated with gull roosts suggests a dependence on light intensity and yielded an appropriate decay coefficient used in the water quality model, CE-QUAL-W2 (UMass, 1996 & 1998).

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[1] Stratified lakes are described as having three zones: the upper epilimnion, the metalimnion (commonly called the thermocline), forming a boundary between waters of different temperature; and the bottom hypolimnion.

2.4 Water Quality

The main goal of watershed protection is to maintain a high water quality in the supply reservoir. Superior water quality depend on many natural and built watershed features. Natural watershed features influencing water quality include: reservoir morphology, watershed hydrology, geology/topography/soils, vegetative cover, and wildlife. Built environmental features include: land use and extent and type of development. The previous three sections provided an overview of these factors. This section provides a summary of the water quality in the Quabbin Reservoir and Ware River watersheds, and how it relates to tributary water quality and in-reservoir processes.

Key Points:

Quabbin Reservoir and Ware River Intake

- A high quality and reliable source of drinking water, Quabbin Reservoir has crystalline water with low turbidity, bacterial counts, algal densities, and nutrients.
- The reservoir meets the SWTR source water quality criterion for unfiltered systems.
- The detection of *Giardia* and *Cryptosporidium* at the reservoir's intakes has been very low. For Quabbin Reservoir, more than 98% of total samples have been below the detection limit for *Giardia* and *Cryptosporidium* since March 1995. No confirmed organisms have been found in the Reservoir's Chicopee Valley Aqueduct (CVA) intake since monitoring began in 1995.

Tributaries

- The tributaries in the Quabbin Reservoir and Ware River watersheds during the diversion period, usually have clear water, low bacterial counts, and low nutrient levels.
- Turbidity and fecal coliform in the tributaries fluctuate in response to storm flows and other conditions.
- The overall detection of *Giardia* and *Cryptosporidium* in the Quabbin Reservoir and Ware River watersheds was higher than at the aqueduct. The lower pathogen incidence at the intake locations suggests that there may be attenuation of pathogen levels through in-reservoir processes such as dilution, settling or die-off.
- Biomonitoring conducted in watershed streams provides assessment of long-term conditions of stream health.

The DWM runs a comprehensive, on-going monitoring program, which is described in **Section 8.1**. There has been a significant amount of water quality data collection for the Quabbin Reservoir and its tributaries, as well as for the Ware River intake, and its tributaries. MDC/DWM annually reports its water quality data, including fecal coliform bacteria, pathogens, and nutrients within both watersheds. DWM and DEP conducted a collaborative water quality study of Quabbin Reservoir and its watershed, collecting data on various water quality parameters, including total and fecal coliform and nutrients (MDC and DEP, 1989). In 1995, DWM and MWRA established a regular monitoring program for pathogens, which was supplemented in 1997 with data collected to comply with EPA's Information Collection Rule (ICR).

A formal compilation or review of water quality data collected by DWM and these other sources has not been performed, because DWM is currently reviewing ten years of tributary water quality data, and anticipates completion in 2001. This assessment is attempting to combine the most recent water quality data from these various sources including biomonitoring, focusing on data for fecal coliform bacteria, pathogens, nutrients, phytoplankton, and natural organic matter. The objective is to present a concise and accurate summary of water quality conditions in the reservoir, at the Ware River intake, and within the watershed tributaries.

2.4.1 Conventional Water Quality Parameters

Table 2-8 summarizes selected conventional water quality parameters, according to data collected for the reservoirs and tributaries by DWM from 1990 through 1999. Ranges indicate minimum and maximum values for the data record evaluated (with obvious outliers omitted).

Table 2-8

Typical Values of Selected Conventional Water Quality Parameters

for Quabbin Reservoir Watershed and Ware River Watershed

1990-1999

	Quabbin Reservoir Watershed		*Ware River Watershed*	
Parameter	*Tributaries*	*Reservoir: Site 202 (Median)*	*Tributaries*	*Ware River Intake Shaft 8 (Median)*
pH	4.7 – 7.5	6.54	5.2 – 7.4	6.3
Standard Alkalinity (mg/l as $CaCO_3$)	0.8 – 39.3	4.1	0.8 – 97.5	4.7
Color	8 – 130	5	5 – 360	65
Turbidity (NTU)	0.1 - 10	0.3	0.2 – 7.5	0.8

Source: (MDC/DWM Quabbin Laboratory, 2000)

2.4.2 Fecal Coliform Bacteria

There are two regulatory requirements that relate to fecal coliform bacteria levels in the Quabbin Reservoir. The SWTR requires that fecal coliform bacteria in the source water (i.e., raw water intakes) of unfiltered systems meet the following standard: at least 90% of the samples collected in the previous 6-month period must have levels less than 20 CFU/100 ml. There is no standard for source water quality of filtered systems. The Massachusetts water quality standards require that fecal coliform bacteria in reservoir or tributary waters with Class A designations not exceed an arithmetic mean of 20 CFU/100 ml, or 10% of the samples exceed 100 CFU/100 ml.

Table 2-9 summarizes fecal coliform data collected by DWM in recent years, in terms of medians and the percentage of samples that exceed the 20 CFU/100 ml threshold for unfiltered surface water supplies. Quabbin Reservoir has very low median bacterial counts, and rarely exceeds the 20 CFU/100 ml threshold. Quabbin Reservoir meets the SWTR requirement for unfiltered systems, as shown in **Figure 2-7**. As DWM's gull control program has been implemented effectively and roosting gulls were relocated, the roosting gull population declined, and coliform levels fell. Summer concentrations of fecal coliform bacteria, historically much lower than winter levels, have also decreased. The potential reasons for this trend are a reduction in nesting birds or other wildlife, and improved housekeeping practices around the Chicopee Valley Aqueduct (CVA).

Table 2-9

Regulatory Fecal Coliform Bacteria Levels for Quabbin Reservoir

Year	*Quabbin Reservoir at Winsor Power Station (aka CVA Intake-predisinfection) (% 20 CFU/100ml*)*
1994	2%
1995	2%
1996	4%
1997	0%
1998	0%
1999	0%

Source*:* (MDC/DWM Quabbin Laboratory, 2000)

* 20 colony forming units/100 ml is both a SWTR standard and MA Water Quality standard for unfiltered systems.

Monitoring of tributary water quality is not required by the SWTR or other regulations. DWM conducts extensive monitoring of tributaries as a tool to identify sub-basin areas requiring special attention for watershed management activities, as well as to track overall water quality and identify any trends, including improvements resulting from watershed management actions.

The watershed tributaries have low fecal coliform medians, though higher than the reservoir. **Figure 2-8** shows how bacteria levels fluctuate in a large tributary, the East Branch of the Swift River, in the Quabbin Reservoir watershed.

Time series of fecal coliform concentrations at the Ware River Intake, presented in **Figure 2-9**, show that the spikes in bacteria levels occur occasionally, and most frequently in the summer and fall. No increasing or decreasing trends are apparent in these time series, but there appears to be a seasonal cycle of bacteria concentrations, which tend to be higher in the summer. The higher bacteria levels may be attributed to decreased dilution during the summer months, when tributary flows are lowest. Smaller tributaries have, for the most part, similar trends to the major tributaries.

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Figure 2-7
Fecal Coliform Counts - Winsor Power Station (201)

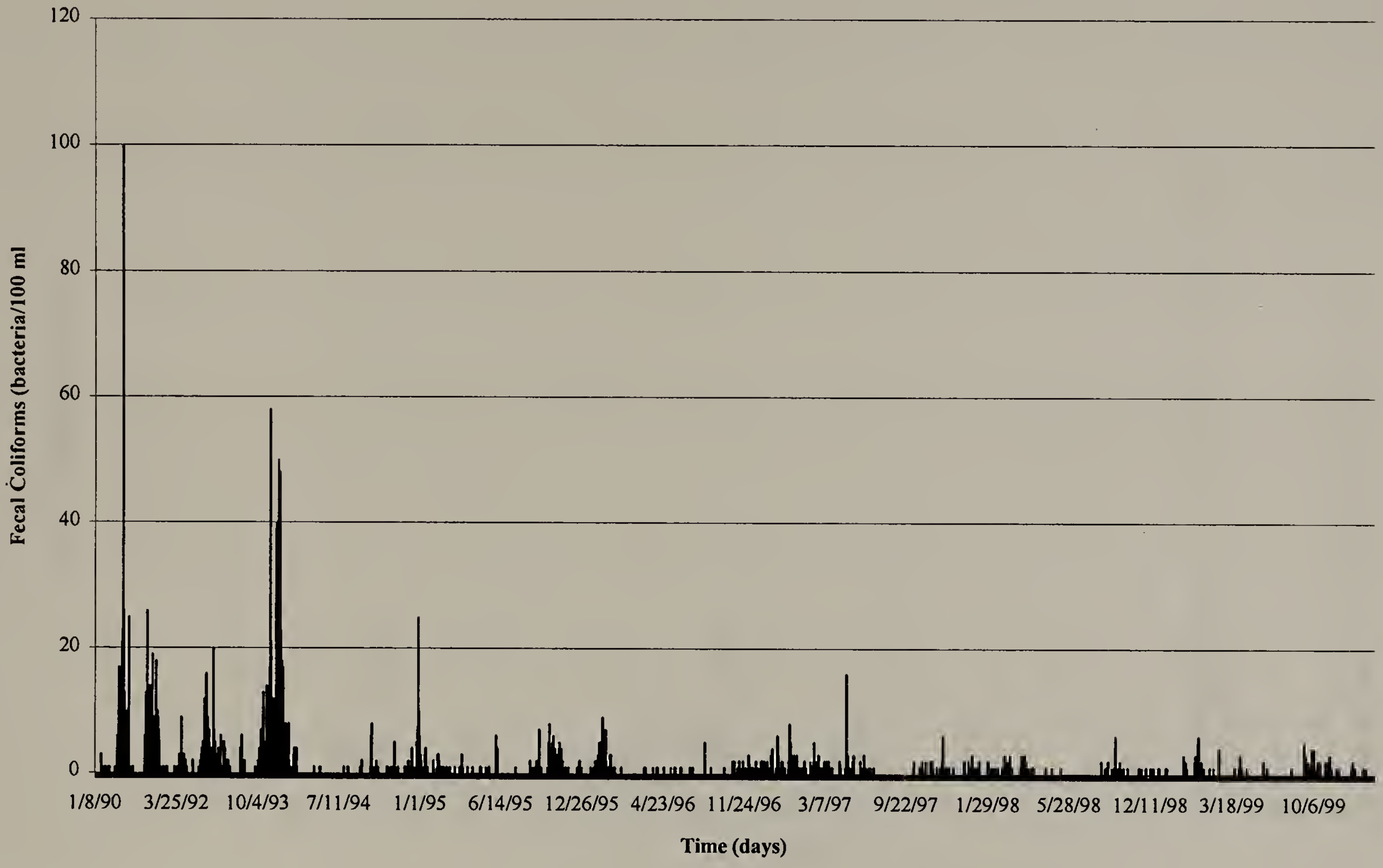

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Figure 2-8
Fecal Coliform Counts - East Branch Swift River (216)

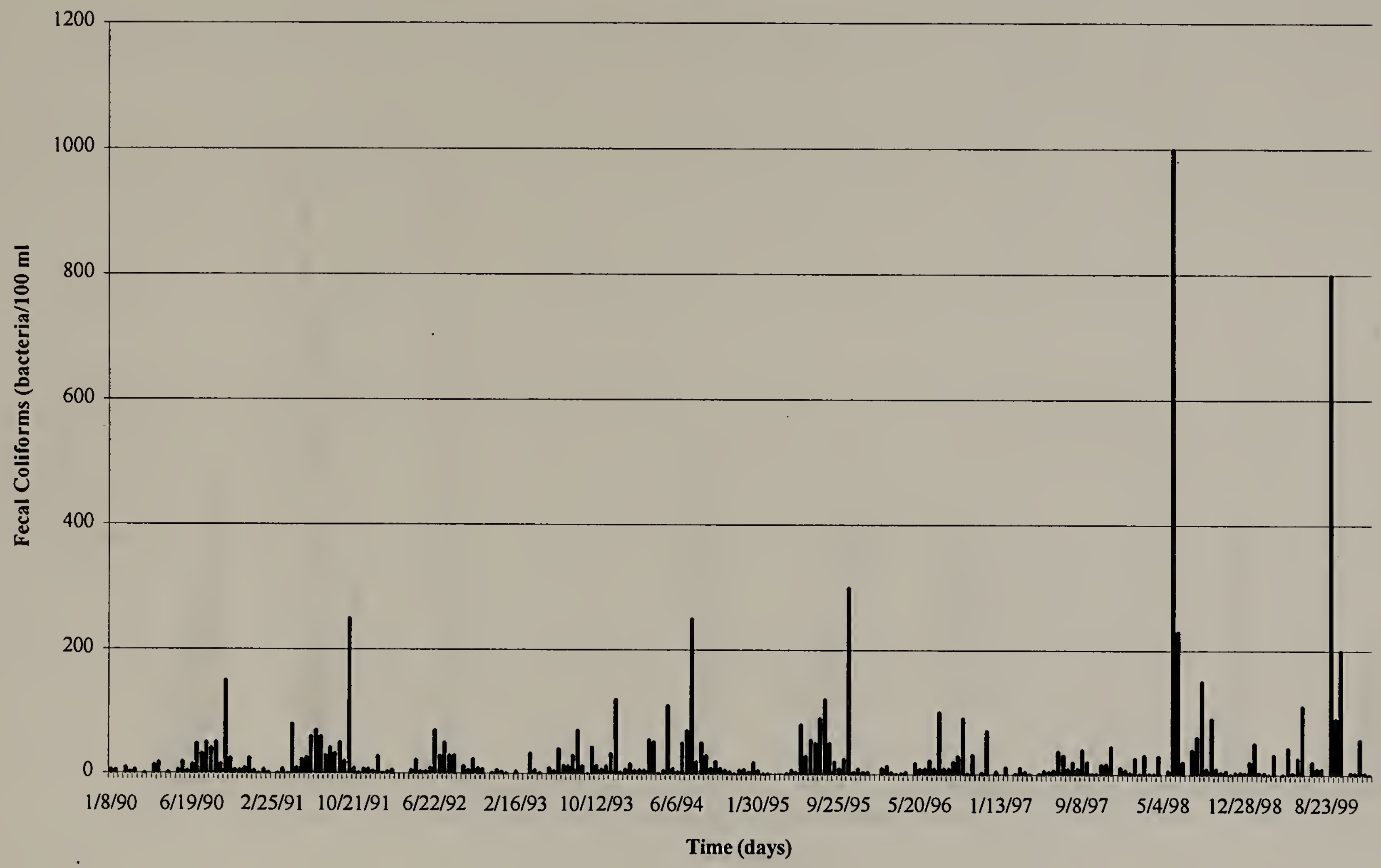

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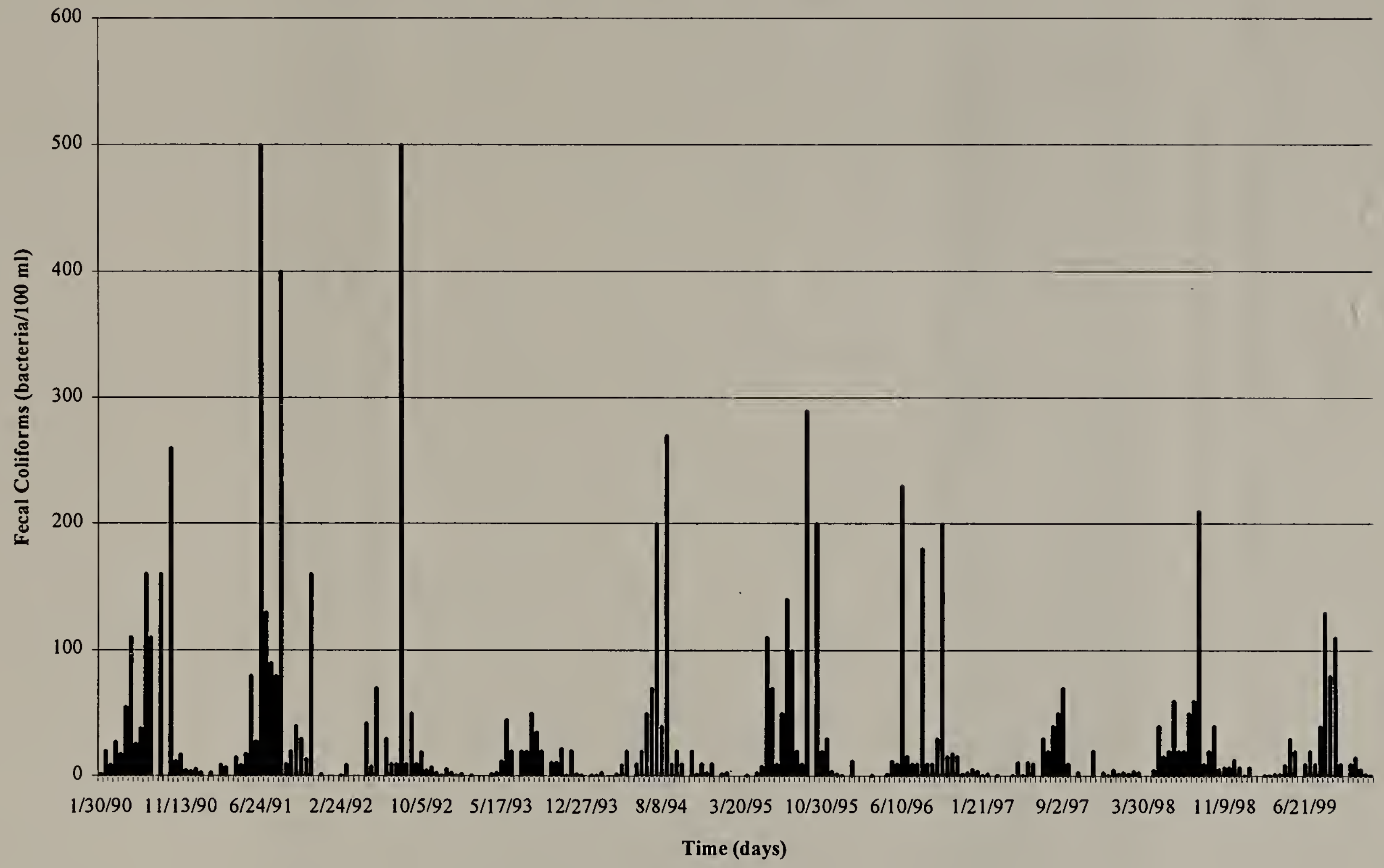
Figure 2-9
Fecal Coliform Counts - Ware River Intake (Shaft 8)



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Tables 2-10 and 2-11 summarize the fecal coliform data collected by DWM for the main tributaries of the Quabbin Reservoir and Ware River watersheds. Fecal coliform data tends to have a high degree of variability in these streams, as evidenced by the large standard deviations. Averages for most of the tributaries and the Ware River exceed 20 CFU/100 ml, but medians are usually lower, suggesting that these higher averages are due to occasional spiking in the data rather than sustained elevated levels.

Table 2-10

MDC/DWM Quabbin Reservoir Watershed Tributaries
Fecal Coliform Bacteria Data 1990–1999

Tributary	Annual Flow %	Fecal Coliform Colonies Per 100 ml (Membrane Filtration)					
		Median	Average	Std. Dev.	Average Fecal Coliform		
					%≥20	%≥100	%≥300
East Br. of Swift River @ Rte. 32A	17	9	30	87	33.7%	5.3%	1.1%
West Br. of Swift River @ Rte. 202	5	4	15	33	23.8%	1.9%	<1%
Middle Br. of Swift River @ Gate #30	5	15	52	205	44.4%	9.7%	1.6%
East Br. of Fever Brook @ West Road	4	3	25	86	26.3%	5.7%	1.2%
West Br. of Fever Brook @ Womens Fed.	2	5	18	33	26.4%	2.5%	0%
Hop Brook @ Gate 22	2	13	39	75	42.1%	10.5%	2.2%
Cadwell Creek @ Mouth	<2	5	23	88	23.8%	4.3%	<1%

Source: (MDC/DWM Quabbin Laboratory Records, 2000)

Note: Fecal coliform has been monitored in Quabbin Reservoir tributaries on a bi-monthly (i.e., twice per month) basis since May 1990. Prior to that time monitoring was performed weekly on major tributaries and bi-monthly on secondary tributaries.

Table 2-11

MDC/DWM Ware River Watershed Tributaries

Fecal Coliform Bacteria Data (1990–1999)

Tributary	Fecal Coliform Colonies Per 100 ml (Membrane Filtration)					
				Average Fecal Coliform		
	Median	Average	Std. Dev.	%≥20	%≥100	%≥300
Ware River @ Shaft 8	10	31	69	32.4%	9.2%	1.2%
Ware River @ Barre Falls Dam	27	67	128	72.7%	46.0%	3.6%
East Branch Ware @ New Boston Rd.	13	48	89	45.8%	14.2%	2.7%
West Branch Ware @ Rte. 62	10	63	145	41.8%	18.5%	4.8%
Burnshirt River @ Rte. 62	6	25	70	32.9%	5.2%	<1%
Canesto/Natty Brook @ Rte. 62	10	36	95	37.5%	7.6%	2.0%
Longmeadow Brook @ mouth	16	71	153	49.1%	17.5%	5.7%
Natty Pond Brook @ Hale Road	4	21	39	28.8%	5.2%	0%
Parker Brook	7	25	58	32.5%	5.6%	<1%

Source: (MDC/DWM Quabbin Laboratory Records, 2000)

Note: Fecal coliform has been monitored in Ware River Watershed tributaries on a bi-monthly (twice per month) basis since May 1990. Prior to that time monitoring was performed monthly.

In Quabbin Reservoir, tributary sources of bacteria also appear to have a limited impact on reservoir concentrations. An intensive study of the West Arm of Quabbin Reservoir, in the vicinity of the Chicopee Valley Aqueduct (CVA), conducted by University of Massachusetts, examined the effect of bacteria loads to Quabbin Reservoir. This study, which involved extensive field work and modeling, showed that tributaries are not significantly correlated to the seasonal increases in fecal coliform levels observed at the CVA. Quabbin tributaries contribute low bacteria loads to the reservoir, since they have low bacteria levels. In addition, the elongated shape and massive size of the reservoir results in long detention times for most of the major tributaries, which allows for significant bacterial decay (Tobiason et al., 1998).

Roosting gulls are the primary source of fecal coliform bacteria to the reservoir intake according to sampling results from the recent University of Massachusetts study of Quabbin Reservoir (Tobiason et al., 1998). Bacteria from tributaries do not appear to reach the CVA intake in the Quabbin Reservoir.

2.4.3 Pathogens

Pathogens studied in the Quabbin Reservoir and Wachusett Reservoirs and their inflows include: *Giardia*, *Cryptosporidium*, and enteric viruses.

Giardia* and *Cryptosporidium

MWRA and DWM conduct extensive sampling for *Giardia* and *Cryptosporidium* in the watersheds, reservoirs, and transmission system. Testing began on a periodic basis in 1988, using the most current methods available at the time. Later in 1994, more comprehensive programs of watershed and reservoir sampling began. These programs are summarized below.

- February 1994 to January 1995: CDM collected samples as part of the Wachusett Reservoir Water Quality: Interim Assessment Study (CDM, 1995b). ASI laboratory analyzed the samples using the cartridge filtration immunofluorescence assay (IFA) proposed by EPA.

- March 1995 to June 1996: MWRA and DWM staff collected samples which Morrell Laboratories analyzed using the IFA method. MWRA recognized the limitations of the high detection limits on data interpretation, and requested that the laboratory conduct microscopy on multiple slides. After May 1995, detection limits were lowered to an average of 4 organisms/100L. In its analysis, Morrell Laboratories used the protocols and procedures available at that time. MWRA and CDM have expressed concerns about this data set based on QA/QC data; however, it is included as part of the total body of data.

- July 1996 to present: MWRA and DWM collected samples, which Erie County Laboratories analyzed using the IFA method. DWM/MWRA instructed the laboratory to conduct microscopy on as many slides as necessary to maintain a detection limit greater than 1 organism/100L.

- July 1997 to December 1998: CDM collected monthly samples (under contract to MWRA), which Erie County Laboratories analyzed as required by EPA's ICR.

CDM's and MWRA/DWM's initial testing efforts (February 1994 to June 1996) focused on familiarizing staff with sampling procedures and trying to "find" the organisms in the water sampled. For these reasons, the sites chosen were those most likely to have *Giardia* or *Cryptosporidium*, and over 20 different locations were sampled through the watersheds. Later sampling programs (July 1996 to present) focused on a smaller number of fixed stations. Samples for the Quabbin system are collected at the CVA intake with select sites in the Reservoir and within the Quabbin Reservoir watershed.

Table 2-12 summarizes the Giardia and Cryptosporidium results for the Quabbin Reservoir watershed system since March 1995.

The detection of *Giardia* and *Cryptosporidium* in the intake/system samples has been extremely low for the Quabbin Reservoir watershed system. For *Giardia*, 98% of Quabbin samples were below the detection limit; for *Cryptosporidium*, 98% of Quabbin samples were below the detection limit. No confirmed[2] organisms have been found at the CVA intake.

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[2] Terminology used to describe cysts/oocysts with at least two visible internal structures.

Table 2-12

Summary of Quabbin System Testing Results for *Cryptosporidium sp.* and *Giardia sp.*

(March 1995 - June 1998)

Location	*No. of Samples*	*# of Samples Below Detection Limit*[+]	*% Below Detection Limit*	*% Confirmed*	*# Confirmed Samples (internal structures)*	*# Presumed Samples (empty or amorphous oocysts)*	*% Presumed*
Cryptosporidium sp.							
CVA Intake	53	50	94.3%	0.0%	0	3	5.7%
Reservoir[*]	11	7	63.6%	27.3%	3	4	36.4%
Watershed[*]	12	6	50.0%	8.3%	1	6	50.0%
Giardia sp.							
CVA Intake	53	52	98.1%	0.0%	0	1	1.9%
Reservoir[*]	11	4	36.4%	36.4%	4	7	63.6%
Watershed[*]	12	8	66.7%	16.7%	2	4	33.3%

[*] All watershed and in-reservoir samples were collected between March 1995 and June 1996 and analyzed by Morrell laboratories.

[+] Detection limits for most CVA Intake samples are low, below 1.0 cysts per 100 Liters. The three presumed *Cryptosporidium* samples (empty or amorphous oocysts) averaged 0.8 oocysts per 100 Liters.

In the Quabbin system, the detection of *Giardia* and *Cryptosporidium* in the reservoir and watershed was higher than in the intake/system, but existing data is limited and questionable. A small number of samples (11 for the reservoir and 12 for the watershed) were collected sporadically in 1995 and 1996. These samples, which were analyzed by Morrell Laboratories, constitute the data set previously mentioned as having a low "comfort level" due to QA/QC concerns.

Enteric Virus

MDC/DWM-MWRA attempted to study enteric viruses in 1994. Enteric virus samples were collected during the 1994-95 CDM study in Wachusett Reservoir, its watershed and the Quabbin Aqueduct. Actual measurements were made of total culturable viruses. Since 1997, as required by EPA's Information Collection Rule (ICR), MWRA sample for total culturable viruses at the Cosgrove Intake. While no enteric virus were detected in the 1994-95 or 1997 samples, they were detected twice at very low levels in 1998 (1.02/100 L and 0.97/100 L). MWRA continues to collect virus samples monthly.

Sources

Potential sources of pathogens to the Quabbin Reservoir include: tributary inflows, transfers from the Ware River watershed, and in-reservoir sources such as birds. According to the monitoring data, tributary inflows to Quabbin Reservoir appear to be a source of pathogens. It is unclear how far the findings related to fecal coliform bacteria apply to pathogens since pathogens require a longer time to die-off or to settle (due to smaller size and density). While attenuation is apparent in the data, a detailed analysis to quantify the significance of attenuation due to in-reservoir processes has not yet been conducted.

2.4.4 Nutrients

2.4.4.1 Nutrients in the Quabbin Reservoir

Beginning in 1998, MDC/DWM staff initiated a yearlong program of monthly sampling of Quabbin Reservoir in order to document current nutrient dynamics and to update the existing database on nutrient conditions in the basin. This effort was undertaken, in collaboration with MWRA staff at the Deer Island Central Laboratory who performed the laboratory analysis, and with personnel from the University of Massachusetts Department of Civil and Environmental Engineering (UMass-CEE). The program entailed collecting samples simultaneously at all sampling stations for the 1999 water year. The results of the UMass-CEE sampling and analysis are summarized in **Section 2.4.7**. Results from the nutrient sampling program confirm that Quabbin Reservoir is an oligotrophic system characterized by very low rates of nutrient input and biological productivity (**Table 2-13**).

Table 2 - 13
Summary of Laboratory Results for Sampling Program[3]
October, 1998 through September, 1999

Parameter	*Detection Limit*	*Range of Station Medians in Samples from Epilimnion (Surface)*	*Range of Station Medians in Samples from Metalimnion*	*Range of Station Medians in Samples from Hypolimnion (Bottom)*
Total Phosphorus (µg/L)	5 µg/L	<5	<5 - 6	<5 - 6
Ammonia-Nitrogen (µg/L)	5 µg/L	<5	<5 - 5	<5 - 10
Nitrate-Nitrogen (µg/L)	5 µg/L	<5 - 6	<5	7 - 18
Total Inorganic Nitrogen (µg/L)	10 µg/L	<10 - 13	<10 - 11	13 - 28
Total Kjeldahl-Nitrogen (mg/L)	600 mg/L	<0.6	<0.6	<0.6
Silica (mg/L)	10 mg/L	1.21 - 1.34	1.12 - 1.31	1.27 - 1.56
Alkalinity (as $CaCO_3$) (mg/L)	10 mg/L as $CaCO_3$	2.34 - 2.76	2.24 - 2.90	2.46 - 2.78

TROPHIC STATE CRITERIA
(epilimnetic values; from Wetzel, 1983)

Trophic Category	Total Phosphorus	Total Inorganic Nitrogen
ultra-oligotrophic	<5 µg/L	<200 µg/L
oligo-mesotrophic	5 - 10 µg/L	200 - 400 µg/L

Source: (MDC/DWM – Environmental Quality, 2000)

The results of the nutrient sampling program can be summarized as follows:

- Results confirm "ultra-oligotrophic" status (Wetzel, 1983) of Quabbin Reservoir based on very low concentrations of total phosphorus and total inorganic nitrogen.

- Spatial variation in nutrient concentrations at stations across the basin was minor except for relatively higher concentrations of total phosphorus, silica, and alkalinity at Den Hill (due to the influence of the East Branch of the Swift River) and a slight gradient in silica concentrations (see below).

- Concentrations of ammonia, nitrate, and silica exhibited marked seasonal and vertical variations due to demand by phytoplankton in the trophogenic zone (epilimnion and metalimnion) and decomposition of settling phytoplankton in the tropholytic zone (hypolimnion).

- Ammonia and nitrate were depleted in the trophogenic zone in spring and remained below or near the detection limit of 5 µg/L until fall turnover, whereas concentrations increased in the tropholytic zone from August through fall turnover.

- Minimum concentrations of silica were measured in the metalimnion in July and August, whereas hypolimnetic concentrations increased from September through fall turnover; a slight gradient of decreasing concentrations is evident between stations proximate to watershed loading sources (Den Hill and West Arm) and stations in the central basin "downgradient" from those sources (Mt. Pomeroy and Carrick Island).

- Concentrations of total phosphorus were low throughout the year at all stations and depths with levels generally remaining below or near the detection limit of 5 µg/L. This indicates that phosphorus is a limiting nutrient for Quabbin Reservoir phytoplankton. (Nitrogen is also well below 200 µg /L).

- During the November through April mixing period, no vertical gradients were observed in the water column, and concentrations of most nutrients were intermediate concentrations between summer extremes measured in the trophogenic and tropholytic zones.

2.4.4.2 Nutrients in Tributaries to the Quabbin Reservoir

Beginning in 1998, MDC/DWM staff initiated a program of monthly sampling and field measurements (temperature, dissolved oxygen, pH, and specific conductance) of the 12 major tributaries to Quabbin Reservoir. The objective of the program is to document current nutrient loadings and to augment the existing database on tributary water quality. This effort was undertaken with personnel from the University of Massachusetts Department of Civil and Environmental Engineering (UMass-CEE), who conducted a field component by collecting samples simultaneously at identical locations, in collaboration with the MWRA's Department of Laboratory Services which provided laboratory analyses. Current research by UMass-CEE staff and graduate students is focused on characterizing natural organic matter (NOM) in Quabbin Reservoir and quantifying NOM fate and transport within the basin (**Section 2.4.7**).

Grab samples were collected monthly, weather and ice conditions permitting, at the 12 major tributaries (**Table 2-14**). A list of the parameters measured, details of the sample preservation, holding times, and detection limits are summarized in **Table 2-15**.

Table 2-14

Drainage Areas of Twelve major Quabbin Tributaries

Tributary Name	*Drainage Area (sq. miles)*	*Percent of Total Watershed*
Cadwell Creek	2.89	2.0%
Purgee Brook	2.65	1.8%
Atherton Brook	2.59	1.8%
West Branch Swift River	12.42	8.4%
Dickey Brook	4.36	3.0%
Prescott Brook	2.64	1.8%
Underhill Brook	2.13	1.4%
Hop Brook	5.43	3.7%
Middle Branch Swift River	10.65	7.2%
West Branch Fever Brook	4.47	3.0%
East Branch Fever Brook	8.71	5.9%
East Branch Swift River	43.65	29.6%
Totals	**102.59**	**69.6%***

Source: (MDC/DWM, 1999)
* The surface area of the Quabbin Reservoir is 39.4 sq. miles, approximately 27.8% of the watershed.

Table 2-15

Quabbin Tributary Nutrient Analyses

Parameter and Method	*Preservation*	*Holding Time*	*Detection Limit*
Total Phosphorus EPA - 365.4	Sulfuric Acid	28 days	5 µg/L
Ammonia-Nitrogen EPA - 350	Filtered and Frozen	indefinite	5 µg/L
Nitrate-Nitrogen EPA - 353.2	Filtered and Frozen	indefinite	5 µg/L
Total Kjeldahl-Nitrogen EPA - 351.2	Sulfuric Acid	28 days	600 µg/L
Silica EPA - 200.7	Nitric Acid	28 days	10 µg/L
Alkalinity EPA - 310.1	Refrigeration	14 days	10 µg/L as $CaCo_3$

Source: (MDC/DWM – Environmental Quality, 2000)

The results of the MDC/DWM nutrient sampling program (**Table 2-16**) agree closely with the findings of the U.S.G.S. (Lent *et. al.*, 1998) who identified three main sub-basins composing the Quabbin Reservoir watershed based on principle components analysis of tributary water chemistry data. These three sub-basins consist of the following: the West Sub-basin (including Cadwell Creek, Purgee Brook, Atherton Brook, and West Branch Swift River), the Central Sub-basin (including Dickey Brook, Prescott Brook, Underhill Brook, and Hop Brook), and the East Sub-basin (including Middle Branch Swift River, West Branch Fever Brook, East Branch Fever Brook, and East Branch Swift River). The USGS study characterized the West Sub-basin as relatively inert with low acid neutralizing capacity and minimal export of nutrients and organic matter. In contrast, the East Sub-basin was demonstrated to have greater acid neutralizing capacity and to be the most significant source of nutrients and organic matter exported from the watershed. Finally, the Central Sub-basin was found to have the highest acid neutralizing capacity of the three sub-basins, but to have a minor role in exporting nutrients and organic matter.

Results of the MDC/DWM sampling program confirm the importance of buffering processes and wetland biogeochemical processes in determining tributary water quality within each major sub-basin. Tributaries in the West Sub-basin have the lowest values of alkalinity and pH indicative of low buffering capacity. The highest buffering capacity is evident in tributaries of the Central Sub-basin where maximum values of alkalinity and pH are measured. Tributaries of the East Sub-basin exhibit intermediate values of alkalinity and pH.

Table 2-16

Comparison of MDC/DWM Water Quality Parameters in USGS Classified Major Sub-basins[3]

Water Quality Parameters	Median Range in West Sub-basin (Cadwell, Purgee, Atherton, and W. Swift)	Median Range in Central Sub-basin (Dickey, Prescott, Underhill, and Hop)	Median Range in East Sub-basin (Mid. Swift, W. Fever, E. Fever, and E. Swift)
Total Phosphorus (µg/L)	10 - 12	13 - 15	13 - 20
Ammonia-Nitrogen (µg/L)	all < 5	all < 5	5.1 - 11.4
Nitrate-Nitrogen (µg/L)	6 - 50	16 - 66	10 - 15
Total Kjeldahl-Nitrogen (mg/L)	all < 0.6	all < 0.6	all < 0.6
Silica (mg/L)	8.21 - 9.14	8.72 - 9.98	2.97 - 5.21
Alkalinity (mg/L as $CaCO_3$)	0.67 - 2.16	5.08 - 6.90	4.45 - 5.37
Hydrogen Ion Activity (pH)	5.4 - 5.8	6.3 - 6.6	5.9 - 6.5
Specific Conductance (µS/cm)	35.8 - 69.0 except Purgee = 80.7	33.8 - 35.2 except Hop = 88.1	50.8 - 79.9

Source: (MDC/DWM, 1999)

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[3] A detailed report on the results of the tributary sampling program referenced here is available from the MDC/DWM.

The results of the MDC/DWM's sampling program validate the USGS (1998) identification of three main sub-basins composing the Quabbin watershed. This delineation allows MDC/DWM to expand the water quality characterization of each of their major tributaries, and enables the quantification of the phosphorus load to Quabbin Reservoir from each tributary. The foremost water quality characteristics of each sub-basin are:

- The West Sub-basin is relatively inert with low buffering capacity (low pH and alkalinity) and low concentrations of the nutrients phosphorus and ammonia. However, concentrations of the nutrients nitrate and silica in the West Sub-basin are similar to the Central Sub-basin and higher than the East Sub-basin.

- The Central Sub-basin has the highest buffering capacity (highest pH and alkalinity) and moderate concentrations of phosphorus and ammonia. Hop Brook is notable in this sub-basin as having consistently elevated concentrations of nitrate (median concentration = 66 µg/L).

- The East Sub-basin has intermediate buffering capacity and relatively high concentrations of phosphorus and ammonia. West Branch Fever is notable in this sub-basin as having elevated concentrations of total phosphorus (median concentration = 20 µg/L) and ammonia (median concentration = 11.4 µg/L). However, concentrations of nitrate and silica in the East Sub-basin are lower than either of the other sub-basins. Biogeochemical processes in the extensive wetlands of the East Sub-basin are the main cause of the disparities in nutrient concentrations compared to other sub-basins.

2.4.5 Phytoplankton in Quabbin Reservoir

Most of the biological productivity in the Quabbin Reservoir ecosystem is attributable to phytoplankton; these organisms are linked directly to aesthetic properties of the water such as clarity, taste, and odor. During the 1999 water year, MDC/DWM staff evaluated the taxonomic composition, density, and seasonal dynamics of the plankton community in the Quabbin Reservoir through a program of monthly sampling at the six main sampling stations within the basin.

A total of approximately 40 phytoplankton taxa were observed in the quantitative samples collected during the year of study. Total densities ranged from 36 to 900 ASUs/ml with seasonal variations in density and community composition generally consistent across all sampling stations.

The sampling program was initiated near the end of one growing season (October, 1998), continued through the winter period of minimal activity, and encompassed most of the next growing season (**Figure 2-12**). The results of the sampling program, however, are presented chronologically, starting with the winter lull in phytoplankton activity through the beginning of a single growing season to its end. This presentation approach is useful and appropriate due to the regularity of phytoplankton dynamics from year to year. A detailed report on the results of the sampling program referenced here is available from the MDC/DWM Environmental Quality Section (MDC/DWM, 2000).

The seasonal succession of phytoplankton in Quabbin Reservoir followed a pattern characteristic of many temperate, oligotrophic systems (**Figure 2-10**). During the winter period of low temperatures and light intensities growth by phytoplankton was sufficient only to maintain low population densities. Total densities in January 1999, ranged from 217 to 284 ASUs/ml (no samples in February or March due to ice cover).

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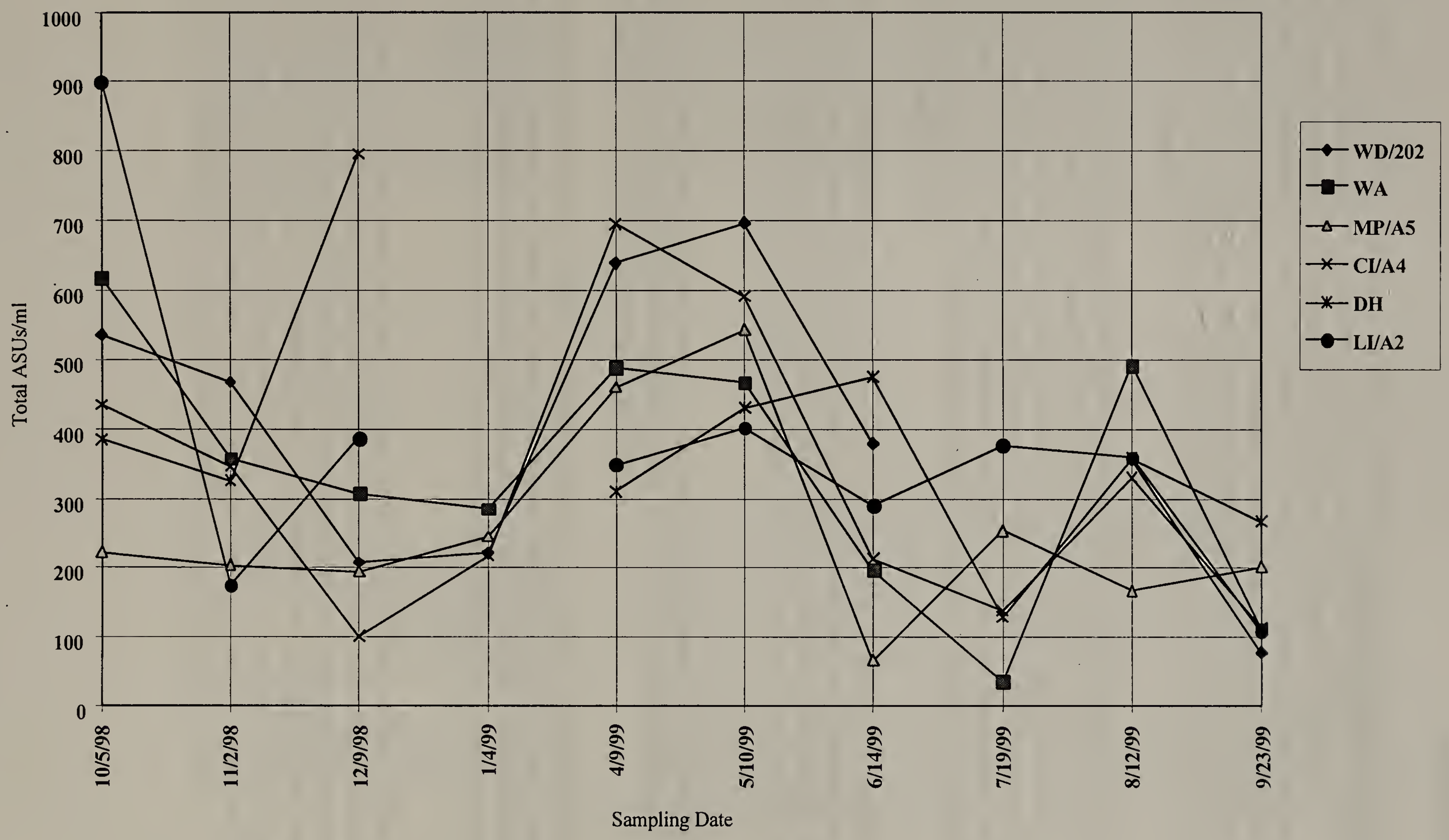
Figure 2-10

Summary of 1998-99 Plankton Counts at Quabbin Reservoir



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Phytoplankton growth was triggered in the spring as light conditions improved and water temperatures increased. Populations expanded rapidly during the period of spring turnover (late March and April) and reached a spring maximum dominated by diatoms in May at the onset of thermal stratification. Phytoplankton densities ranged from 309 to 696 ASUs/ml in the samples collected in April and May with diatoms composing an average of 47 percent of total densities across all sampling stations (**Figure 2-11**). The most abundant diatom of the spring maximum was *Asterionella* followed by *Cyclotella*, *Tabellaria*, *Rhizosolenia*, and *Synedra*. The chrysophyte *Dinobryon* and the cyanophyte *Microcystis* also contributed significantly to the spring maximum.

The spring maximum of phytoplankton populations depleted the supply of major nutrients in the trophogenic zone (**Section 2.4.4**) resulting in subsequent population declines as growth was offset by losses due to sedimentation. Phytoplankton densities in June ranged from 66 to 379 ASUs/ml except at Den Hill where populations of diatoms continued to increase slightly between the May and June sampling dates (430 to 475 total ASUs/ml respectively). The persistence of diatoms at Den Hill in June when populations had declined at all other stations, is likely due to the greater rate of nutrient supply delivered to this sampling station from East Branch Swift River (**Section 2.4.4**).

Diatoms were observed only infrequently through the summer and early fall, being replaced mainly by low densities of cyanophytes (mostly *Microcystis*), chrysophytes (mostly *Dinobryon*), and chlorophytes. Phytoplankton densities ranged from 36 to 376 ASUs/ml in the samples collected in July through September, except at Western Arm (Station A6) where the chlorophyte *Gloeocystis* contributed 176 ASUs/ml to a total of 492 ASUs/ml in August.

The general pattern of a fall maximum in phytoplankton densities such as observed in October, 1998, followed by population declines coinciding with the onset of low winter light intensities and water temperatures is characteristic of temperate oligotrophic systems.

Measurements of Secchi transparency in 1998-99 are consistent with the pattern of phytoplankton dynamics described in **Figure 2-12**. Greatest transparencies were observed in June through August with a maximum value of 14 meters (46 feet) recorded at Mt. Pomeroy (Station A5) on July 19, 1999. The great clarity of the water in the summer months coincides with the low phytoplankton densities that followed the spring maximum in April and May.

In a system protected from watershed alterations and increases in nutrient loading, such as Quabbin Reservoir, the seasonal periodicity of phytoplankton populations is similar from one year to the next. Historical records of Secchi transparency measurements dating back to 1990 provide evidence of regularity in the annual pattern of phytoplankton dynamics (Figure 2-13). Low transparencies are evident each spring and fall on either side of regular peaks in transparency occurring each summer. As in 1998-99, the historical peaks in transparency correspond to low summer phytoplankton densities. These peaks are inserted between spring and fall periods of reduced transparency, corresponding to spring and fall maximums in phytoplankton density.

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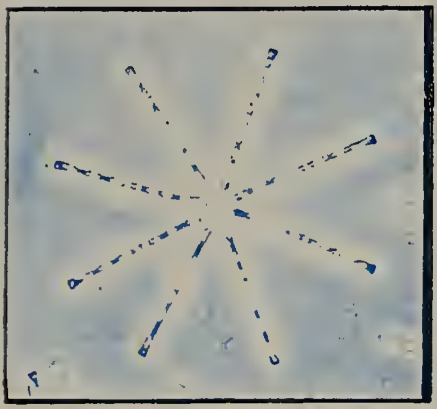
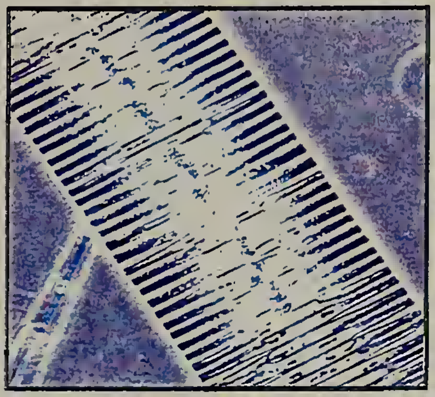
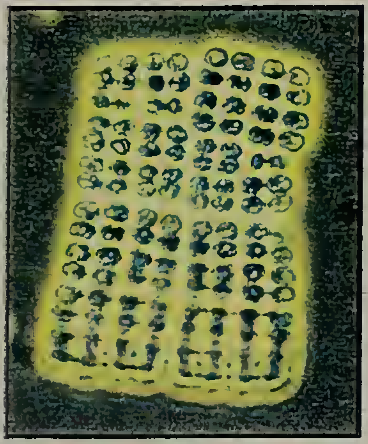
Figure 2-11 – Examples of Phytoplankton Found in Quabbin Reservoir



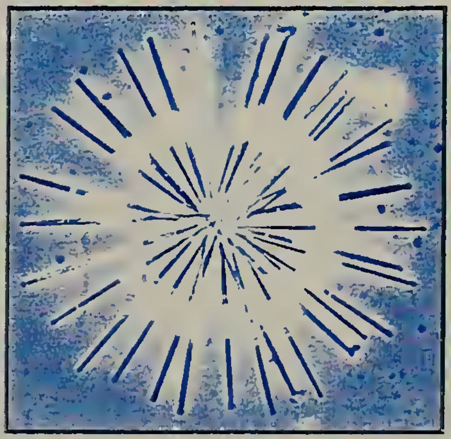
Asterionella formosa



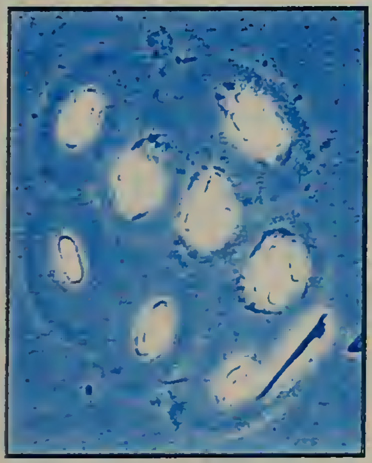
Fragilaria crotonensis



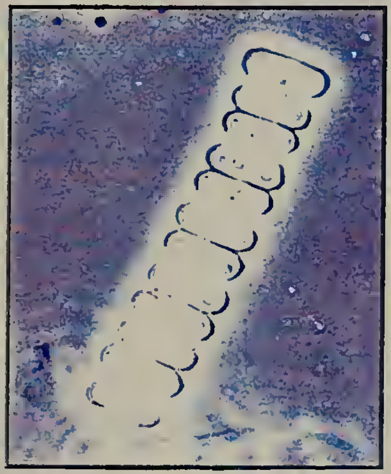
Merismopedia spp.



Synedra acus



Quadrigula spp.



Spondylosium spp.

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Figure 2-12

Secchi Transparency in Quabbin Reservoir: 1998-99

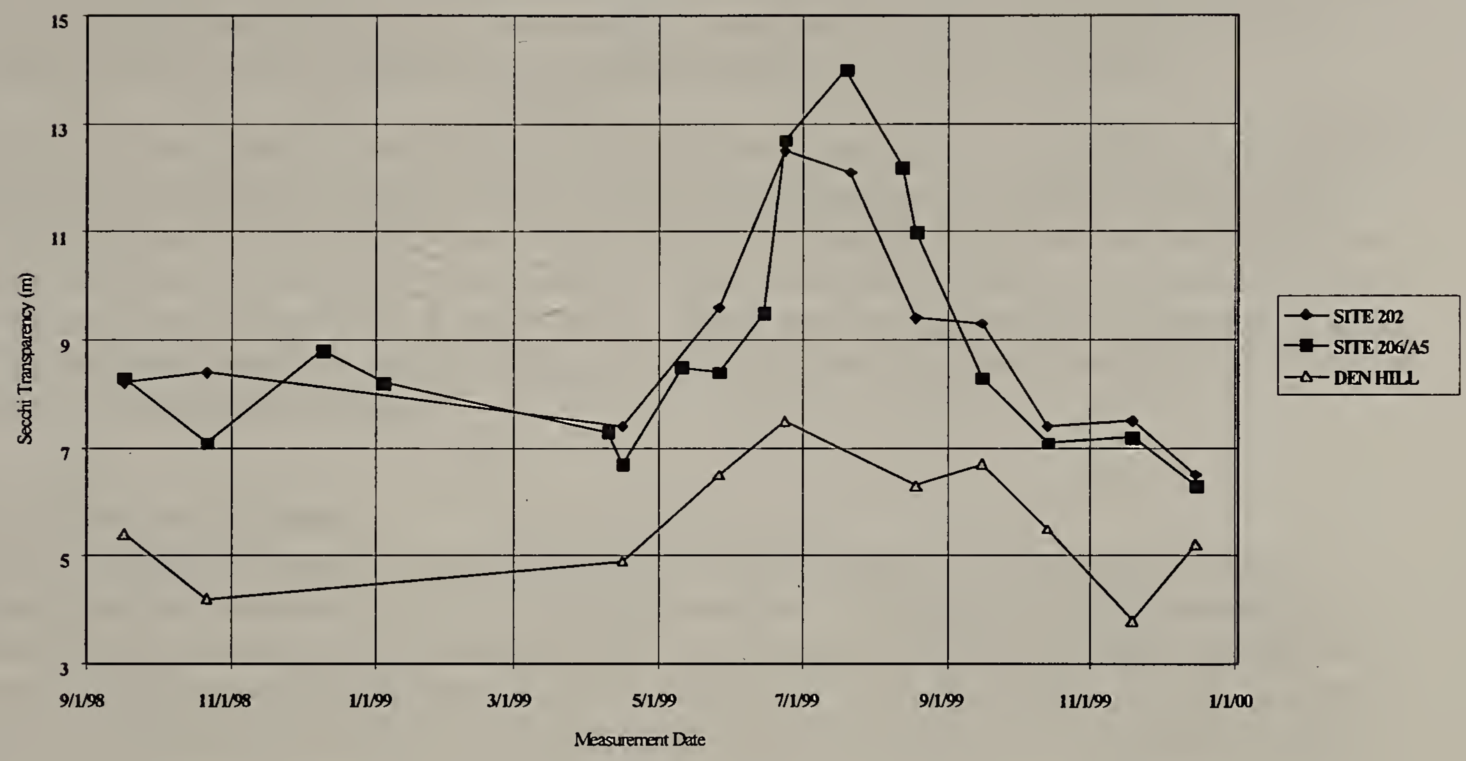
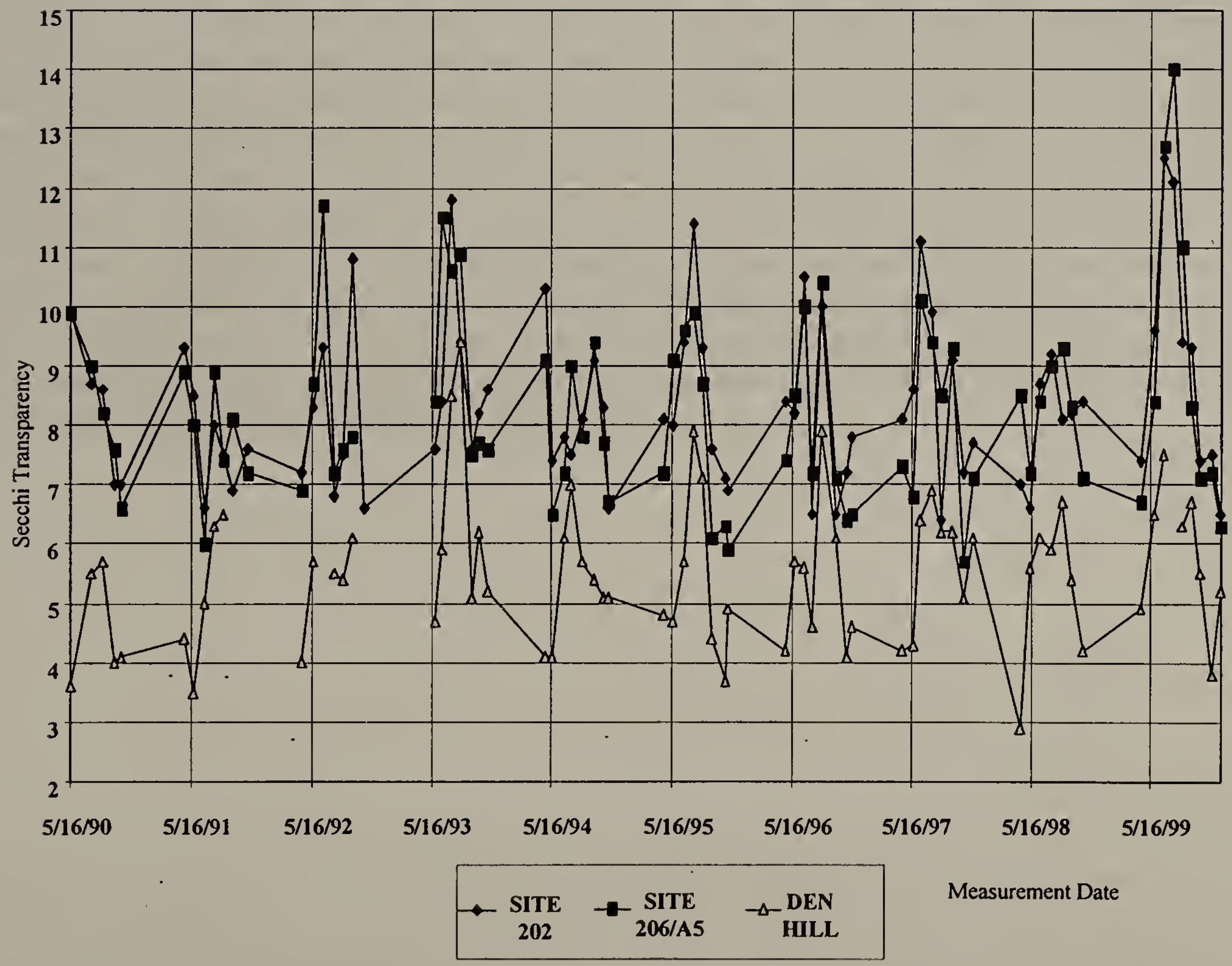


Figure 2-13

Secchi Disk Measurements in Quabbin Reservoir: 1990 - 1999



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2.4.6 Biomonitoring

To supplement other water quality monitoring efforts, DWM has conducted biomonitoring in selected tributaries to the Quabbin Reservoir and on branches of the Ware River. Biomonitoring involves collecting samples of insects from tributary streams and comparing the community structure observed with those of "reference" stations. It provides a description of long-term cumulative conditions in streams.

Initial biomonitoring efforts aimed to provide an overview of insect populations in the Wachusett watershed. Fifty-five samples were collected in 1988, 1989, and 1990, excluding only those tributaries that lacked adequate habitat for sample collection. Samples were also collected from the Quabbin Reservoir and Ware River watersheds in 1990, 1992, and 1994. Forty samples were collected from sixteen locations including two reference stations: East Branch of the Ware River and West Branch of the Swift River. Most tributaries contained healthy diverse populations with the exception of Natty Brook, Hop Brook, and Cadwell Creek. A detailed assessment of the data is underway.

2.4.7 Natural Organic Matter

The MDC/DWM is supporting research by the University of Massachusetts Civil and Environmental Engineering Department on water quality in MDC/DWM reservoirs. One objective of this research is to identify the sources and to understand the transport and fate of Natural Organic Matter (NOM) in Quabbin Reservoir. NOM is a component of disinfection demand, and a precursor to the formation of disinfection byproducts such as trihalomethane (THM). This research is important to MWRA's overall public health protection goals.

The first phase of research consists of determining reservoir inputs, outputs, and in-reservoir concentrations of NOM on a spatial and temporal scale. Samples were collected from the mouths of twelve major tributaries in the Quabbin Reservoir watershed, from the reservoir outlets (CVA and Quabbin Aqueduct) and from an in-reservoir transect of six sampling locations at which three samples were collected from different depths (**Table 2-17**). NOM was measured as total and dissolved carbon (TOC and DOC, respectively). In addition, several analyses providing insight on the character of the NOM were conducted, including measures of UV_{254} absorbance, trihalomethane formation potential (THMFP), and the apparent molecular weight distribution (AMWD). In-reservoir processes affecting NOM were also investigated. Algal dynamics were examined using measurements of algal densities and nutrient concentrations (algal density and nutrient concentration data were collected by DWM staff). The biodegradability of the organic carbon in the reservoir and tributaries was investigated through measurements of the biodegradable dissolved organic carbon (BDOC) concentration. Sedimentation of particulate organic matter was examined by sediment trap experiments. Analysis of results is ongoing and will be completed and reported to the MDC/DWM in 2000. Some illustrative results are presented in **Figures 2-16, 2-17, & 2-18**.

Table 2-17

NOM Sampling Analysis - Quabbin Reservoir Watershed 1997-1999

Analysis	*Samples*	*Sampling Duration*	*Frequency of Analysis*
TOC, DOC, UV254	All Samples	October 1997 – September 1999	All Sampling Events
THMFP	All Samples	October 1997 – September 1999	Monthly
Particle Counts	All Samples	November 1997-April 1999	All Sampling Events
AMW	4-5 Tributaries 2-3 Reservoir sites 2 Depths	April 1998 – September 1999	Monthly
Chlorophyll-a	3 Reservoir Sites 3-5 Depths	July 1998 – July 1999	Monthly
BDOC	2-3 Reservoir Sites 4-5 Tributaries	November 1998	Nov., Jan., Feb., Mar., Apr., Jun., Jul., Sept.
Stage	All Tributaries except Purgee Brook	October 1997 – September 1999	All Sampling Events (not as frequent during the winter due to freezing)

Source: (UMass/CEEE, 2000)

TOC concentrations for the 12 major tributaries ranged from less than 2mg/L to over 10 mg/L. **Figure 2-16** includes data from the Middle Branch Swift River, West Branch Fever Brook, East Branch Fever Brook, and East Branch Swift River. These tributaries, which drain into the eastside of the reservoir, typically had the highest TOC concentrations in the watershed. In addition to spatial variability across the tributaries, TOC concentrations showed temporal variability. **Figure 2-16** shows elevated TOC concentration in the summer.

In-reservoir TOC concentrations are included in **Figure 2-17** and generally range from about 2 mg/L to 2.7 mg/L, with occasional concentrations near or above 3 mg/L at the Den Hill location. In comparison with the tributary TOC concentrations, the organic carbon levels in the reservoir are lower than the watershed tributary concentrations. For all sites except Den Hill, TOC concentrations are slightly elevated during the summer months. Spatial variability across the tributary sites is not significant or consistent, with the exception that the TOC concentrations at Den Hill tend to be higher than the other reservoir sites. The Den Hill site is located in the east branch, and is most directly influenced by the higher TOC tributary inputs.

TOC and DOC concentrations in Quabbin Reservoir outlets are similar to observed concentrations in the water column. The average TOC concentration in CVA water was 2.22 mg/L, and the average Quabbin Aqueduct TOC was 2.18 mg/L. TOC and DOC levels in **Figure 2-18** show that the organic carbon leaving the reservoir is predominantly in the dissolved form. The CVA and Quabbin Aqueduct intakes both draw water from below the thermocline during periods of thermal stratification. The results presented in **Figure 2-18** show that there are insignificant temporal and spatial gradients in this hypolimnetic water. The organic carbon concentrations in the reservoir are low, relatively constant, and consistent with the oligotrophic state of the system. The low organic carbon concentrations in Quabbin Reservoir are good for drinking water supply, as raw water with low organic carbon concentration tends to have lower chlorine demand and a lower concentration of THM precursors.

Figure 2-14

Total Organic Carbon Measured in Select Tributaries of the Quabbin Reservoir Watershed, 1997-1999

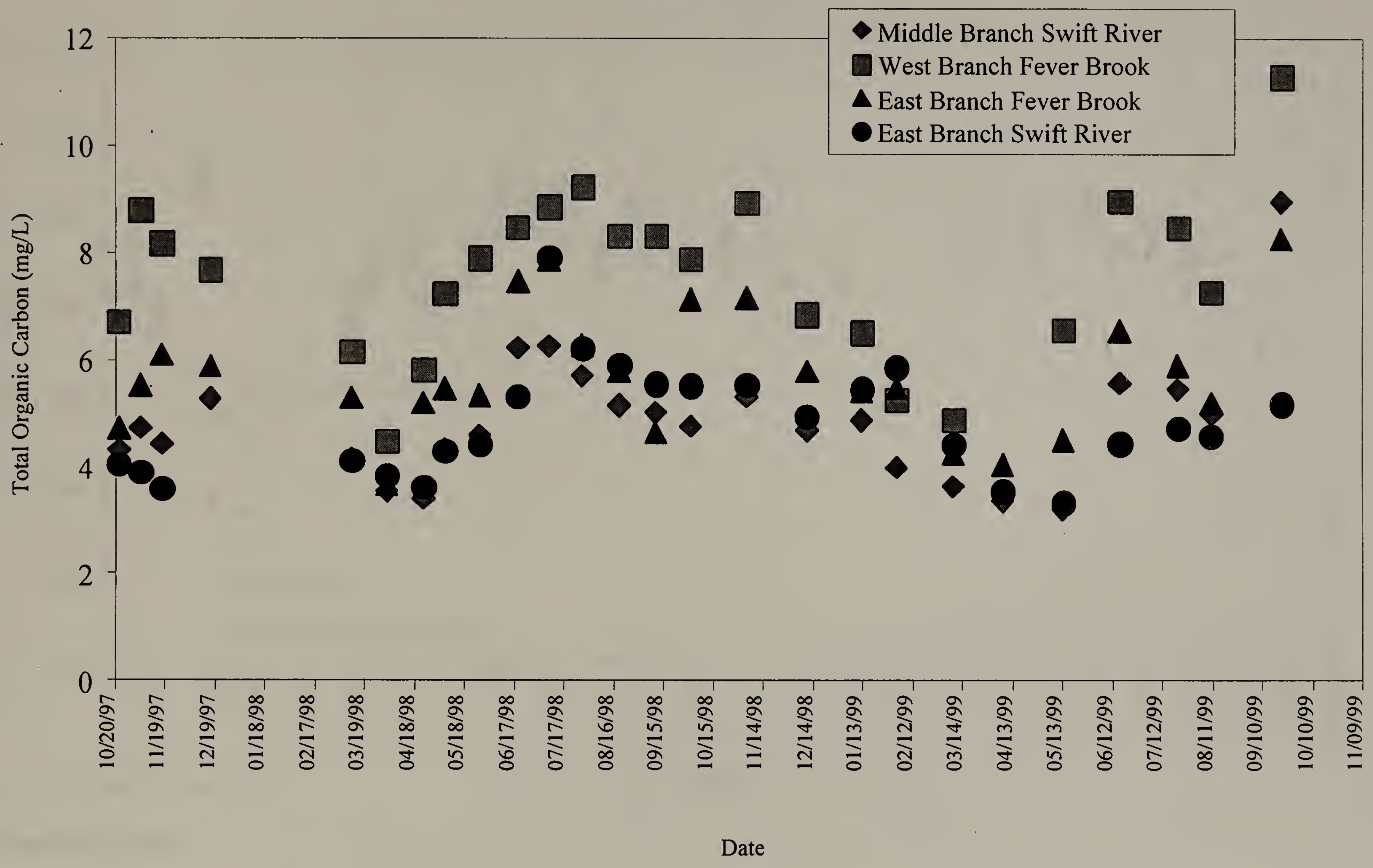

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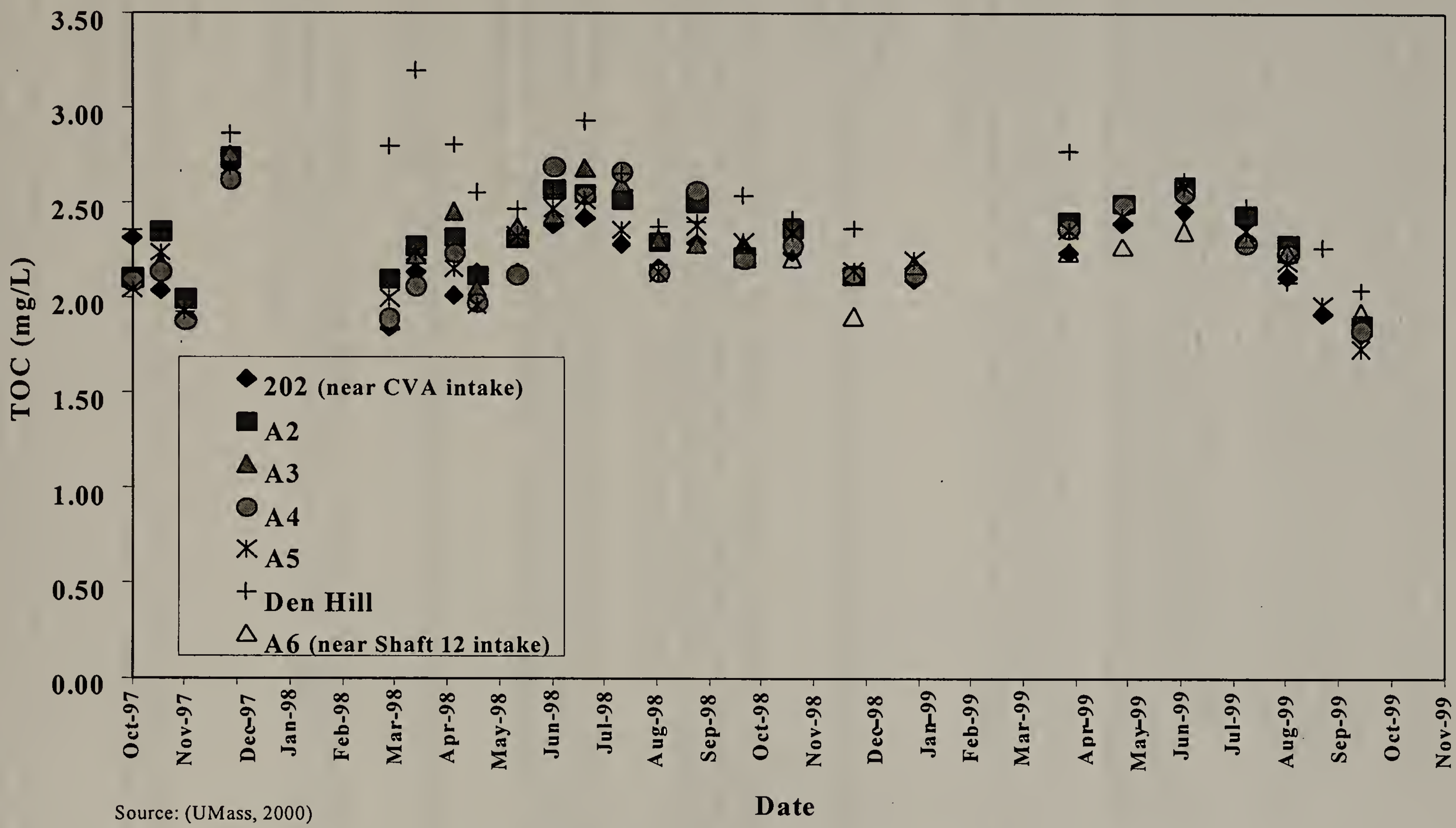
Figure 2-15
Total Organic Carbon (scaled) Collected at Depth at Quabbin Reservoir
1997-1999



Source: (UMass, 2000)

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2.5 Zones

Key Points

- MA DEP has defined three management zones–Zones A, B, and C–for the purpose of watershed protection, based on the 100-year floodplain elevation and the distance upgradient from this boundary (310 CMR 22.02).
- Currently, DWM has defined and uses seven watershed protection zones in the Quabbin Reservoir and Ware River watersheds for specific programs, including pathogen prevention, intake protection, enforcement of the Watershed Protection Act, public access management, and silvicultural programs (including the Controlled Deer Management Program).
- In general, DWM's zones for watershed protection are located within larger management areas (e.g., Quabbin Reservation). These historical management areas are based on the original legislation creating the Quabbin Reservoir watershed and Ware River watershed systems as well as subsequent legislation (e.g., Kelly-Wetmore Act).

MDC/DWM and MA DEP have delineated different management zones for different aspects of watershed protection. These zones, discussed below, are intended to guide priorities and actions based on the relative importance of portions of the watersheds to water quality. The zones vary, depending on the general or specific watershed protection goal.

2.5.1 MA DEP Zones

MA DEP has defined three management zones for the purpose of watershed protection of public surface water drinking water supplies:

- **Zone A**: land area between the surface water source and the upper boundary of the bank; the land area within a 400 foot lateral distance from the upper boundary of the bank of a Class A surface water source, as defined in 314 CMR 4.05(3)(a); and the land area within a 200 foot lateral distance from the upper boundary of the bank of a tributary or associated surface water body.

- **Zone B**: land area within on-half mile of the upper boundary of the bank of a Class A surface water, as defined in 314 CMR 4.05(3)(a), or edge of watershed, whichever is less. However, Zone B shall always include the land area within a 400 foot lateral distance from the upper boundary of the bank of the Class A surface water source.

- **Zone C**: land area not designated as Zone A or B within the watershed of a Class A surface water source, as defined at 314 CMR 4.05(3)(a).

These zones have been delineated for the Quabbin Reservoir and Ware River watersheds, and are presented in the 1991 Watershed Protection Plans (MDC, MWRA, and Rizzo Associates, 1991a & b). Zone C areas were very small and were combined with Zone B areas.

2.5.2 DWM Zones

Currently DWM has designated seven zones in the Quabbin Reservoir and Ware River watersheds for specific watershed protection programs and management purposes. These zones are summarized below and discussed in greater detail throughout the Plan.

- **Intake Protection Zones**: Located in both watersheds, these three areas exclude general public access near the three intakes within the Quabbin Reservoir (see **Sections 4.2** and **4.3**). These three protection zones are: Quabbin Aqueduct Intake Protection Zone, Chicopee Valley Aqueduct Intake Protection Zone, and Ware River Intake Protection Zone.

- **Primary Protection Zone/Secondary Protection Zone**: These terms are used for the implementation of the Watershed Protection Act. The Primary Protection Zone refers to the 200 foot no-build zone described in Section 5 of the Plan (see **Section 5.1**).

- **Aquatic Wildlife Pathogen Control Zone**: Area in which animals of concern (e.g., beaver and muskrat) are surveyed and removed (see **Section 6.1**).

- **Bird Control Zone**: Area in which animals of concern (e.g., gulls and Canada geese) are surveyed and removed (see **Section 6.1**).

- **Watershed Ranger Patrol Zones**: Areas of MDC owned land monitored daily by the Watershed Ranger program. These two patrol zones are: Quabbin Reservoir Watershed Patrol Zones and Ware River Watershed Patrol Zones (see **Section 4.3**).

- **Controlled Deer Management Program Zones**: Areas on MDC lands designated for access to trained hunters during a limited period (3-5 days) yearly to control deer populations which inhibit and prevent tree regeneration. These five zones are: Pelham Zone, Prescott Zone, Petersham Zone, New Salem Zone, and Hardwick Zone (see **Section 6.1**).

2.5.3 DWM Management Areas

In general, the DWM uses historical land management systems in the Quabbin Reservoir and Ware River watersheds. The most common system is based on past legislation forming the system and subsequent legislation. This system classifies six areas in the watershed system, discussed below. In addition, the DWM may use other historic management systems including the Sanitary Districts (and sub-districts) and forestry blocks (and compartments), depending on the watershed protection project.

- **Quabbin Reservoir (and islands)**: Along with Quabbin Reservation, this area, controlled entirely by the MDC/DWM, requires the highest level of protection.

- **Quabbin Reservation**: Along with the Quabbin Reservoir, this area, controlled entirely by the MDC/DWM, also requires the highest level of protection. This management area encompasses the sub-basins immediately adjacent to the reservoir.

- **Off-Reservation/Quabbin Reservoir watershed**: This management area consists of MDC/DWM controlled lands and waters that are generally outside the major highways surrounding the Quabbin Reservation and Reservoir.

- **Quabbin Park**: Wholly controlled by the MDC/DWM, most of this area falls outside the Quabbin Reservoir's watershed.

- **Ware River Reservation**: This area includes all MDC/DWM controlled lands and waters within Routes 122, 122A, 56, 68, and 62, and is subject to restrictions set forth in Ch. 737 of the Acts of 1972 (a.k.a. the "Kelly-Wetmore" Act).

- **Off-Reservation/Ware River watershed**: This area includes MDC/DWM controlled lands and waters within the Ware River watershed excluding the Ware River Reservation. Generally, this area consists of the lands and waters outside of Routes 122, 122A, 56, 68, and 62.

Section 3
Overview of MDC/DWM Watershed Protection Goals and Programs

This section describes the mandate and the goals of the Metropolitan District Commission (MDC) Division of Watershed Management (DWM). DWM is the agency responsible for protection of the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds. The assessment and ranking of potential contamination sources, originally developed in the 1991 Plan, is updated. The updated ranking reflects the water quality goals and emphasizes prevention of pathogens. In addition, this section presents an overview of DWM's watershed protection and management programs, which follow from the goals and priorities. Lastly, this section presents the conceptual framework of ownership and protection of critical lands, partnership with watershed communities to ensure future protection, and direct action to correct the few existing impacts.

3.1 Mission

MDC, a state agency within the Executive Office of Environmental Affairs, has been charged with protection of the Quabbin Reservoir watershed and Ware River watershed since the early 1900s. MDC was established when Chapter 372 of the Acts of 1984 divided the former MDC Water Division into the new DWM, responsible for watershed operation and management, and the new Waterworks Division of the Massachusetts Water Resources Authority (MWRA), responsible for transmission and treatment. DWM is a single-purpose, watershed-focused unit of MDC.

DWM's mission is derived primarily from its enabling legislation and subsequent amendments, found at M.G.L. Chapter 92, § 104 - 120. The statute directs the DWM to:

> *"...construct, maintain and operate a system of watersheds, reservoirs, water rights and rights in sources of water supply [to] supply thereby a sufficient supply of pure water to the Massachusetts Water Resources Authority, and [to] utilize and conserve said water and other natural resources to protect, preserve and enhance the environment of the Commonwealth and to assure the availability of pure water for future generations."*

The body of legislation makes directives on specific management aspects of the watersheds, authorizing DWM to:

- Have the exclusive right and control over all ponds, reservoirs, and other property within the watershed system, and [may] order all persons to keep from entering in, upon or over the waters thereof and the lands of the commonwealth or towns surrounding same;
- Make rules and regulations for the protection of the watersheds;
- Establish the Quabbin Watershed Advisory Committee, the Ware River Watershed Advisory Committee, and the Wachusett Watershed System Advisory Committee (covering Wachusett and Sudbury watersheds); and
- Adopt periodic watershed management plans to provide for forestry, water yield enhancement, and recreational activities, among other purposes.

Beyond its broad mandate, DWM has additional, specific responsibilities, as provided in various legislative acts. Some of the acts most currently relevant to DWM are listed in **Table 3-1**.

Building on the legislative-defined mission, DWM's charge today has evolved:

- To maintain and operate the source facilities (including dams) safely and efficiently;
- To preserve and improve water quality of the supply sources, through regulation, direct action, and cooperation, as needed to protect public health and to meet state and federal water quality standards;
- To fulfill the watershed protection and management requirements associated with drinking water regulations;
- To implement the specific directives of the legislature, such as providing recreation opportunities balanced with the protection of the water supply sources and promulgating and enforcing rules and regulations for MDC/DWM lands, waters, and protected zones; and
- To involve watershed towns, residents, and the public in appropriate ways in the conduct of the DWM's watershed protection functions.

In addition, DWM has defined water quality goals for the MDC-DWM managed reservoirs, watersheds, water rights, and source waters:

- Primary Goals
  - to prevent waterborne disease,
  - to maintain a high quality source water, and
  - to meet the source water coliform criterion.
- Secondary Goals
  - to reduce/control nutrient inputs to the reservoir,
  - to reduce risk of a chemical or hazardous material spill, and
  - to control general pollutant transport into the reservoir.

Together, the mission, legislation, and water quality goals provide the basis for all of DWM's activities.

Table 3-1

Massachusetts Legislative Acts Relevant to MDC/DWM

Source	Summary
Chapter 488 of the Acts of 1895	Creates Metropolitan Water Board, with diverse duties and authorities, including construction of reservoir by taking waters of the Nashua River.
Chapter 168 of the Acts of 1901, §§ 1,5	Creates Metropolitan Water and Sewage Board.
Chapter 350 of the Acts of 1919, § 123	Creates MDC.
Chapter 375 of the Acts of 1926	Makes additional provisions for the water supply needs of the MDC. Authorizes the construction of the Wachusett-Coldbrook Tunnel. Limits the diversion from the Ware River.
Chapter 321 of the Acts of 1927	Authorizes creation of reservoir by taking waters of the Swift River, and diverse related activities.
Chapter 21 of the Acts of 1931, § 1	Grants bird management authority.
Chapter 77 of the Acts of 1932	Authorizes removal of game fish from Wachusett for stocking purposes.
Chapter 262 of the Acts of 1932	Authorizes sewer construction.
Chapter 421 of the Acts of 1946	Permits fishing in certain parts of the Quabbin Reservoir (from the shore).
Chapter 300 of the Acts of 1947	Amends Ch. 421 of the Acts of 1946 to allow adoption of regulations governing fishing and water supply protection.
Chapter 737 of the Acts of 1972 (Kelly-Wetmore)	Sets forth rules for the management of Quabbin Reservoir and Ware River watershed lands.
Chapter 204 of the Acts of 1975	Allows MDC administrative rights of entry like those of DWPC.
Chapter 797 of the Acts of 1979	Requires payments in lieu of taxes (PILOT payments) to municipalities.
Chapter 372 of the Acts of 1984	Creates DWM (and MWRA), with diverse duties and authority.
Chapter 734 of the Acts of 1985	Adds to list of organizations from which QWAC membership may be nominated.
Chapter 436 of the Acts of 1990	Amends Ch. 737 of the Acts of 1972 to allow hunting in accordance with a deer management program.
Chapter 36 of the Acts of 1992 (Watershed Protection Act)	Establishes land use restrictions around water features in the watersheds of the Quabbin Reservoir, Ware River, and Wachusett Reservoir; land acquisition authority, and related provisions.
Chapter 242 of the Acts of 1995, §§ 2,3	Creates Ware River Watershed Advisory Committee

Source: (MDC/DWM – EP, 1999)

3.2 Historical Activities

Since the completion of the Wachusett Reservoir in 1908, DWM (and its predecessor, MDC Water Division) has played a major role in reservoir watershed protection and management. Traditionally, the agency's activities have concentrated on managing, operating, and maintaining the water supply system, as summarized below.

> _Watershed Management_: Watershed management activities have included routine water quality monitoring of reservoirs, tributaries, and rivers; sanitary surveys (pollution analyses) of subwatersheds; management of the boat fishing areas at Quabbin Reservoir; and oversight of MDC laws and regulations for the protection of the water supply (originally enforced by the Metropolitan Police, now by the MA State Police, Environmental Police, and the MDC Watershed Rangers). MDC has historically managed its forested lands through such activities as silvicultural operations, planting desired species, wildlife management, and maintaining fire roads and fire lines. MDC also conducts wildlife management within its water-supply lands and waters (e.g., deer impact management program, bird control program, etc.).
>
> _Operations:_ Operations activities have included operating the dams and transfer mechanisms to attain desired reservoir water levels, established with consideration to demand, required downstream flow releases, seasonal flooding prevention, and dam safety. MDC also was responsible for operation and maintenance of the Rutland-Holden Trunk Sewer and Relief Trunk Sewer System and coordination among the towns of Rutland, Holden and Worcester. This function is currently performed by MWRA Sewerage Division.
>
> _Maintenance_: MDC has historically maintained a variety of facilities under its care, such as MDC-owned dams, spillways, bridges, administrative buildings, certain Nashua River bridges, the Quabbin Park Cemetery, and MDC/DWM owned land within the watersheds.

Following the 1984 Acts' creating DWM, DWM's new organization structure, and DWM's newly defined purpose, MDC/DWM's watershed management activities broadened. DWM and its predecessor agency had always maintained an active water quality monitoring program for the tributaries and the reservoirs. DWM re-instituted sanitary surveys and active field inspections to look for pollution sources in the watersheds. After several decades of inactivity, the land acquisition program was re-instituted as well.

To meet the needs of the new organization, as well as the call for source protection in the 1989 Safe Drinking Water Act Amendments (SDWA), MDC/DWM and MWRA prepared Watershed Protection Plans (WPPs or Plans) for the Wachusett Reservoir and Quabbin Reservoir/Ware River watersheds. The Plans were completed in 1991, and represented the first comprehensive watershed studies for water supply protection purposes. The Plans were developed following DEP guidance, and outlined a multi-year program of control measures to prevent water quality impacts from activities on and off MDC/DWM controlled lands.

Following the completion of the 1991 Plans, DWM increased its staff and initiated additional watershed protection programs. Comprehensive sanitary surveys assessing existing and potential pollution threats were conducted for each sanitary district (which were based on sub-drainage basins), forming the foundation for many of DWM's remediation and prioritization efforts. Throughout the 1990s, DWM implemented the Plans, expanding its watershed protection programs to address: recreation and public access, wildlife, construction, on-site septic systems, agriculture, spills, and other water quality issues. From a history of only forestry and land management within the watershed, DWM has grown into a comprehensive steward throughout the watersheds, playing a positive role in controlling land uses and activities related to water quality, to assure availability of abundant high quality water for future generations.

3.3 Overview of Watershed Protection Programs

3.3.1 1991-1999 Program

DWM has fully implemented the 1991 WPPs for Quabbin Reservoir/Ware River Watersheds. DEP has determined annually that these plans and MDC/DWM's activities comply with DEP Policy 89-09 and related guidance (DEP, 2000). **Table 3-2** lists the 1991 threats and specific recommendations to address these threats of the 1991 Plans, and highlights how the activities have been implemented in the Quabbin Reservoir watershed and Ware River watershed.

3.3.2 Assessment of Threats and Current Program

The 1991 Plan included identification of potential sources of contamination, and a ranking of these threats as High, Medium, or Low priority. The 1991 threat priorities were based on the best available information at the time, including DWM knowledge of the land use or activity, federal and state environmental permit records, files from local town boards, land use data, and available maps.

In the years since the Plan's development, DWM completed many studies increasing the available body of watershed and reservoir data. For the Quabbin Reservoir watershed, DWM and UMass-Amherst Department of Civil and Environmental Engineering completed a hydrodynamic study of the reservoir. For both the Quabbin Reservoir and Ware River watersheds, the DWM completed expanded water quality monitoring (including pathogens, studies of other indicator organisms, and biomonitoring), stormwater modeling, various pilot projects such as road Best Management Practices (BMPs), an agriculture inventory, geographic information system (GIS) coverage at a parcel level of detail, wildlife surveys, and sanitary surveys. Also since the 1991 Plan, DWM defined specific water quality goals, incorporating them into the Division's prioritization of activities with an emphasis on minimizing microbial threats in the watersheds.

With DWM's greater knowledge of watershed activities, reservoir hydrodynamics, and water quality, and in the context of defined water quality goals, it is appropriate to revisit the activities and rankings identified in the 1991 Plan. **Table 3-3** summarizes the Division's assessment of the 1991 threats (called potential sources of contamination, according to terminology in the DEP Guidance), the actions proposed in the 1991 plan and the 1991-1999 activities in the Quabbin Reservoir and Ware River watersheds. **Table 3-3** also outlines the changes in the 1991 Threat Priorities including, DEP's Source Water Assessment Program rankings for pollution threats to surface water drinking water supplies. **Table 3-4** represents the newly identified potential sources of contamination, their priority, and the corresponding DWM program(s) and Plan Update sections which address these threats. **Table 3-5** is a revised list of potential contamination sources addressed by section in the updated Plan.

Overall, the new list and ranking shows some shifts since 1991 in the water supply industry and Federal drinking water regulations towards concern for microbial contaminants that can cause acute illness. While MDC/DWM and MWRA remain committed to reducing all potential contaminants in the reservoir, drinking water industry research clearly indicates that control of pathogens must be a top concern. Therefore, activities involving potential exposure to human or animal wastes are high priority for control. Conversely, other types of pollution threats on private lands (such as underground fuel storage tanks and forestry operations) are highly regulated by DEP and DEM, respectively, and typically pose a moderate to low level potential risk, respectively, to surface water quality. For example, forestry on private lands that is required to file a cutting plan under Chapter 132 regulations (3.04 CMR11.00) is likewise carefully monitored by DEM and therefore considered a low priority for MDC/DWM monitoring.

3.3.3 Framework for Programs

MDC/DWM and MWRA are committed to a strong watershed protection program for the Quabbin Reservoir/Ware River/Wachusett Reservoir watershed system, regardless of which treatment system is used. DWM has adopted a three-tiered approach to watershed protection:

1. Protect the most sensitive areas through ownership or agreements with landowners.
2. Work with watershed communities (stakeholders) to increase resource protection and accommodate community needs.
3. Correct existing problems and maintain controls throughout the watersheds.

Over time, existing problems will be eliminated and watershed protection programs will focus on prevention and maintenance. DWM and MWRA believe that this watershed management system provides a drinking water source of exceptionally high quality, and have developed a comprehensive program to ensure that this level of quality will be maintained and enhanced.

Protect Sensitive Areas through Land Ownership and Other Controls

Direct ownership of critical land in the watershed ensures maximum control over land use and provides the best protection of water quality. MDC/DWM is one of the largest landowners in Massachusetts, and MDC/DWM and MWRA are committed to increasing protected land ownership within the watersheds. DWM implemented an aggressive land acquisition program to add to this acreage. A GIS-based acquisition model was developed to prioritize remaining undeveloped parcels for purchase based on greatest benefit to water quality. Annual land acquisition priorities are based on the results of this model. Since 1991, over 4,000 acres of land have been added to MDC/DWM direct holdings in the watersheds of the Quabbin Reservoir and Ware River to increase protection. Currently, the total percentage of MDC/DWM owned land in the Quabbin Reservoir watershed is approximately 57% of the watershed (excluding surface area of the reservoir), and 37% of the Ware River watershed. See **Section 4.1** for more information on MDC/DWM protected lands.

In addition to the land held by MDC/DWM, substantial acreage is protected from development by many other organizations and government agencies that own, maintain, and protect land as open space. This includes town conservation land, parcels held by land trusts and other conservation groups, other state agencies, particularly the MassWildlife, DEM, and other water suppliers (most notably, the City of Worcester). In the case of a state agency with a recreational mission, since 1998 the MDC/DWM has held a Memorandum of Agreement (MOA) with DEM. In the MOA, MDC and DWM agree to coordinate the management of adjacent lands under their respective care and control in order to enhance the protection of water resources.

The total of MDC/DWM-owned and other protected lands is approximately 75% of the Quabbin Reservoir watershed (excluding the reservoir's surface area) and 57% of the Ware River watershed (**Section 4.1**).

Work with Watershed Communities to Ensure Protection for the Future

Since DWM and MWRA must maintain good working relationships with watershed communities to protect water quality, they developed a protection strategy which supplements the direct ownership of the most sensitive lands by working with communities and individual landowners to ensure that development does not degrade water quality. There are many elements within this program. Staff enforce the 1992 Watershed Protection Act (WsPA), ensuring a buffer area between future development and watercourses, and prohibiting land uses of concern within protective zones. A total of 11,011 acres in the Quabbin Reservoir watershed, along with an additional 10,824 acres in the Ware River watershed, are regulated by the Act. There is an ongoing program of technical assistance and outreach for watershed town boards, which oversee many state land use regulations. Direct assistance through DWM presence at meetings and submission of comments, as well as through training, have improved current local governments' regulations, and enforcement of regulations related to development and potential contamination sources such as septic systems. DWM also developed a program to work with owners of large, privately owned forested tracts of land in the watersheds to develop professional forest management plans that protect water quality. MDC/DWM and DEP work closely together and are formalizing their procedures to ensure compliance of key environmental regulations such as Title 5, Stormwater Management Policy, the Wetlands Protection Regulations, and MEPA Regulations. Many of these laws have been strengthened significantly since the 1991 Plans were written, and effectively control both existing and future land uses and activities.

Correct Existing Problems

When the 1991 Plans were written, the watershed assessment did reveal some serious threats to source water quality. Although the watersheds had no point sources (e.g., direct discharges from wastewater treatment plants or industrial sites), there were some nonpoint sources of pollution. Resources were quickly focused on these areas, and remediation measures were developed and implemented. DWM developed and maintains the highly successful gull control program, which greatly reduced the coliform levels at the CVA intake. DWM staff continue to work in the watersheds to identify, evaluate, and monitor any environmental violations and sources of potential pollution. DWM developed and uses a range of tools, from water quality monitoring to site inspections to permit reviews. DWM works with private landowners, town governments, transportation entities, and various state agencies to achieve compliance with Federal, State, and local environmental regulations and to reduce pollution potential in the watersheds.

Sections 4 through 7 present DWM's programs, following the framework of protection, prevention, and remediation. **Section 8** presents the Division's monitoring programs.

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Table 3-2

Self-Evaluation of 1991 Proposed Watershed Protection Activities in the MDC/DWM Watershed Protection Plan Quabbin Reservoir Watershed and Ware River Watershed

1991 Threat	Specific Action Proposed in 1991 Plan	Self-Evaluation – December 2000
High Severity Threats – Quabbin Reservoir and Ware River Watersheds		
On-Site Septic Areas	▪ Provide technical, and consider financial, assistance to repair or replace failing subsurface treatment systems in critical areas through the watersheds. ▪ Conduct study to evaluate septic system functionality in Petersham, MA. ▪ Undertake enforcement and activities through sanitary surveys and monitoring. ▪ Provide technical input in the revision of Title 5. ▪ Develop model regulations and assist in implementation for stronger BOH regulations. ▪ Initiate or support legislation to limit density of development through legislation or zoning. ▪ Prepare materials and conduct educational programs to develop a subsurface sewage disposal "Maintenance and Proper Use Program".	✓Conducted, on-going. ✓Modified, on-going. ✓Conducted, on-going. ✓Conducted, completed. ✓Conducted, on-going. ✓Conducted, completed. ✓Modified, on-going.
Uncontrolled Releases – Transport	▪ Provide input on acceptable transportation routes to reroute transport of hazardous waste and materials to less dangerous roads. ▪ Prepare MOU to undertake emergency planning and response to develop interagency emergency response plan. ▪ Conduct training program to train police to enforce regulations regarding transportation of hazardous waste and materials. ▪ Support regulatory revision for new reporting requirement with transporters to submit annual reports to DWM describing transportation activities. ▪ Prepare MOU for undertaking road improvements, and evaluate structural controls.	✓Conducted, completed. ✓Conducted, completed. ✓Conducted, completed. ✓Conducted, completed. ✓Conducted, completed.

1991 Threat	Specific Action Proposed in 1991 Plan	Self-Evaluation – December 2000
High Severity Threats – Quabbin Reservoir Watershed		
Recreation	▪ Monitor implementation of the recreation and public access plan.	✓Conducted, on-going.
Private logging	▪ Provide technical assistance to extend MDC/DWM's best management practices to private logging within the watersheds. ▪ Complete and implement the MDC/DWM Forest Management Plan (1995-2004).	✓Conducted, on-going. ✓Conducted, on-going.
Animal Populations	▪ Monitor results and evaluate effectiveness of the deer impact management plan. ▪ Conduct studies of alternatives for eliminating water quality impacts of gull and geese.	✓Conducted, on-going. ✓Conducted, on-going.
High Severity Threats – Ware River Watershed		
Future Development	▪ Provide technical and financial assistance to increase local enforcement and regulation of ongoing construction. ▪ Develop model bylaws and assist in implementation of model erosion control bylaws. ▪ Support legislative and regulatory changes to increase MEPA oversight in MEPA regulations.	✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, completed.
Moderate Severity Threats – Quabbin Reservoir Watershed		
Unauthorized Activities	▪ Increase patrols on MDC/DWM watershed lands and throughout the watersheds to increase enforcement of existing local and state regulations regarding recreation, trash disposal, trespassing, and other activities incompatible with watershed protection. ▪ Provide training programs to police to address environmental crimes. ▪ Conduct study to evaluate the feasibility of barriers to deter access and implement findings.	✓Conducted, on-going. ✓Conducted, completed. ✓Conducted, on-going.
Moderate Severity Threats – Ware River Watershed		
Recreation	▪ Monitor implementation of the recreation and public access plan.	✓Conducted, on-going.

1991 Threat	Specific Action Proposed in 1991 Plan	Self-Evaluation – December 2000
Urban Runoff	▪ Participate and provide technical input in rulemaking process for best management practices for storm-water runoff from new development. ▪ Initiate or support state or local legislation to limit impervious cover to 10% per lot in Protection Zone A. ▪ Prepare MOU with MDPW; conduct and implement study to evaluate structural controls to reduce pollutant loads in stormwater. ▪ Locate floor drains and have violations corrected by disconnecting illegal floor drains. ▪ Support legislative and regulatory changes to NPDES to include stormwater runoff; prepare MOU.	✓Conducted, completed. ✓Conducted, completed. ✓Modified, on-going. ✓Conducted, on-going. ✓ Conducted, completed.
Private Logging	▪ Provide technical assistance to extend MDC/DWM's forestry best management practices to private logging within the watersheds. ▪ Complete and implement the MDC/DWM Forest Management Plan.	✓Conducted, on-going. ✓Conducted, on-going.
Herbicides/Pesticides/ Fertilizers	▪ Support regulatory changes of DFA regulations designed to protect supplies. ▪ Support regulatory changes of DFA regulations to receive notification of major applications of pesticides and herbicides. ▪ Support regulatory changes to receive notification of Yearly Operational Plans (YOPs) and to participate in the review of YOPs. ▪ Provide technical assistance to encourage the use of an IPM program.	✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, on-going.
Animal Grazing/Agricultural Runoff	▪ Provide technical assistance to develop a model best management practice policy for local agricultural operations. ▪ Enforce existing regulations to prevent pollution from animal wastes.	✓Modified, on-going. ✓Conducted, on-going.
Future Development/Construction	▪ Provide technical and financial assistance to increase local enforcement and regulation of ongoing construction. ▪ Develop model bylaws and assist in implementation of model erosion control bylaws. ▪ Support legislative and regulatory changes to increase MEPA oversight in MEPA regulations.	✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, completed.
Gravel Mining	▪ Initiate or support state or local legislation to prohibit gravel mining in Protection Zone A. ▪ Develop model earth removal, sand and gravel, and erosion control bylaws and assist in implementation.	✓Conducted, on-going. ✓Conducted, on-going.

1991 Threat	Specific Action Proposed in 1991 Plan	Self-Evaluation – December 2000
Barnyards/Feedlots	▪ See Animal Grazing/Agricultural Runoff	NA
Gasoline/Petroleum Storage	▪ Establish informal agreement with DEP to remediate underground storage tank releases and monitor water quality. ▪ Inventory tanks and provide technical assistance to improve the enforcement of the underground storage tank registration requirements. ▪ Support regulatory changes to amend underground storage tank regulations. ▪ Replace heating systems and remove petroleum tank from intake building.	✓Conducted, completed. ✓ Modified, completed. ✓ Conducted, completed. ✓ Conducted, completed.
Permitted Activities	▪ NA	NA
Erosion	▪ NA	NA
Low Severity Threat – Quabbin Reservoir Watershed and Ware River Watershed		
Road Salting	▪ Review salt use policies to encourage low salt use on roads. ▪ Participate in inventory to monitor outdoor storage supplies of salt.	✓Conducted, on-going. ✓Conducted, on-going.
Uncontrolled Releases – Fixed Sites	▪ Provide input on cleanup priorities by attending monthly coordination meeting to ensure immediate cleanup of Chapter 21E sites ▪ Obtain notification of all releases. ▪ Develop model hazardous materials bylaws and assist in implementation.	✓ Conducted, completed. ✓ Conducted, on-going.
MDC/DWM Logging	▪ N/A	
Low Severity Threat – Quabbin Reservoir Watershed		
Future Development	▪ Provide technical and financial assistance to increase local enforcement and regulation of ongoing construction. ▪ Develop model bylaws and assist in implementation of model erosion control bylaws. ▪ Support legislative and regulatory changes to increase MEPA oversight in MEPA regulations.	✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, on-going.

1991 Threat	Specific Action Proposed in 1991 Plan	Self-Evaluation – December 2000
Urban Runoff	▪ Participate and provide technical input in rulemaking process for best management practices for storm-water runoff from new development. ▪ Initiate or support state or local legislation to limit impervious cover to 10% per lot in Protection Zone A. ▪ Prepare MOU with MDPW; conduct and implement study to evaluate structural controls to reduce pollutant loads in stormwater. ▪ Locate floor drains and have violations corrected by disconnecting illegal floor drains. ▪ Support legislative and regulatory changes to NPDES to include stormwater runoff; prepare MOU.	✓Conducted, completed. ✓Conducted, completed. ✓Modified, on-going. ✓ Conducted, completed. ✓ Conducted, completed.
Herbicides/Pesticides/ Fertilizer Sites	▪ Support regulatory changes of DFA regulations designed to protect supplies. ▪ Support regulatory changes of DFA regulations to receive notification of major applications of pesticides and herbicides. ▪ Support regulatory changes to receive notification of Yearly Operational Plans (YOPs) and to participate in the review of YOPs. ▪ Provide technical assistance to encourage the use of an IPM program.	✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, on-going
Construction	▪ Provide technical and financial assistance to increase local enforcement and regulation of ongoing construction. ▪ Develop model bylaws and assist in implementation of model erosion control bylaws. ▪ Support legislative and regulatory changes to increase MEPA oversight in MEPA regulations.	✓Conducted, on-going. ✓Conducted, on-going. ✓Conducted, completed.
Gravel Mining	▪ Initiate or support state or local legislation to prohibit gravel mining in Protection Zone A. ▪ Develop model earth removal, sand and gravel, and erosion control bylaws and assist in implementation.	✓Conducted, on-going. ✓Conducted, on-going.
Barnyards/Feedlots	▪ See Animal Grazing/Agricultural Runoff	NA

1991 Threat	Specific Action Proposed in 1991 Plan	Self-Evaluation – December 2000
Gasoline/Petroleum Storage	▪ Establish informal agreement with DEP to remediate underground storage tank releases and monitor water quality. ▪ Inventory tanks and provide technical assistance to improve the enforcement of the underground storage tank registration requirements. ▪ Support regulatory changes to amend underground storage tank regulations. ▪ Replace heating systems and remove petroleum tank from intake building.	✓Conducted, completed. ✓Modified, completed. ✓Conducted, completed. ✓Conducted, completed.
Erosion	▪ Conduct study to evaluate the feasibility of construction of sediment forebays in important embayments of the reservoir.	✓Modified, completed.
Animal Grazing	▪ Provide technical assistance to develop a model best management practice policy for local agricultural operations. ▪ Enforce existing regulations to prevent pollution from animal wastes.	✓Modified, on-going. ✓Conducted, on-going.
Permitted Activities	▪ N/A	
Low Severity Threat – Ware River Watershed		
Unauthorized Activities	▪ Increase patrols on MDC/DWM watershed lands and throughout the watersheds to increase enforcement of existing local and state regulations regarding recreation, trash disposal, trespassing, and other activities incompatible with watershed protection. ▪ Provide training programs to police to address environmental crimes. ▪ Conduct study to evaluate the feasibility of barriers to deter access and implement findings.	✓Conducted, on-going. ✓Conducted, completed. ✓Conducted, on-going.
Animal Populations	▪ Monitor results and evaluate effectiveness of the deer impact management plan. ▪ Conduct studies of alternatives for eliminating water quality impacts of gull and geese.	✓Conducted, on-going. ✓Conducted, on-going.
MDC/DWM Logging	▪ NA	NA

Table 3-3

Assessment of 1991 MDC/DWM Water Quality Threat Priorities for the Quabbin Reservoir and Ware River Watersheds vs. MA DEP's 1998 SWAP Threat Ranking

1991 Water Quality Threat Category	DWM's Priority by Watershed 1991		WPP Changes Since 1991	DWM's Priority By Watershed 2000		MA DEP's SWAP[1] Threat Ranking
	Quabbin	Ware		Quabbin	Ware	
Animal Grazing, Agricultural Runoff	L	M	More information now available from Agricultural BMP study; increased concern over farm animals as potential source of pathogens.	L	M	H
Animal Population (Gulls and Beavers)	H	L	DWM has successfully implemented gull control program, aquatic wildlife pathogen control program, including significant data on population, water quality impact, and documented success of harassment, also, local landfills are now closed.	H	L	H (aquatic wildlife)
Barnyards and Feedlots	L	M	More information now available from Agricultural BMP Study; increased concern over farm animals as potential source of pathogens.	M	M	H
On-site Septic System	H	H	Title 5 regulations were revised in 1995.	M	M	M (MB)
Uncontrolled Releases – Transportation	H	H	Transportation Release Controls Study completed.	M	M	H
Construction	L	M	WsPA passed and implemented; local boards have received significant training and input from DWM on project review.	L	M	NA
Pesticide, Herbicide, and Fertilizer Use	L	M	More information now available from Agricultural BMP Study; DWM review of Vegetative Management Plans (VMPs) and annual YOPs.	M	M	H
Recreation	H	M	MDC/DWM updated the Public Access Plans.	H	H	NA
Urban Runoff	L	M	DWM completing Wachusett stormwater Management Study.	M	M	H
Erosion	L	M	Natural erosion is generally limited.	M	M	NA
Gas/Petroleum Storage	L	M	N/A	L	M	H
Gravel Mining	L	M	Few large scale sites in watershed; proper control through local regulations and MDC's Watershed Protection regulations.	M	M	M
Logging	H	M	DWM outreach and use of GIS have resulted in better inventory of private forestry lands.	M	M	M

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[1] SWAP stands for Source Water Assessment Program.

1991 Water Quality Threat Category	DWM's Priority by Watershed 1991		WPP Changes Since 1991	DWM's Priority By Watershed 2000		MA DEP's SWAP[1] Threat Ranking
Uncontrolled Releases – fixed site	L	L	Massachusetts Contingency Plan (MCP) adopted.	L	L	
Permitted Activities – Haz. Waste Generators	H	H	Very few hazardous waste generators in watersheds; WsPA passed.	M	M	H
Permitted Activities – NPDES/GW Discharges	H	H	N/A	M	M	H
Permitted Activities – Solid Waste Facilities	H	H	Landfills within the watersheds are all closed and capped.	M	M	H
Road Salting (Road and Maintenance depots)	L	L	All state and town salt storage sites now covered; sodium is considered less important contaminant in drinking water.	L	L	M
Unauthorized Activities (clandestine activities)	M	L	Watershed Ranger patrols have increased in both watersheds.	M	M	H

Source: (MDC/DWM, 2000)
Key:MB = Microbial threat; H = High threat; M = Moderate threat; L = Low threat

Table 3-4

Potential Sources of Water Contamination, Prevalence, Water Quality Concerns, and MDC/DWM Priorities - 2000

Potential Source of Water Contamination	Prevalence	Water Quality Concerns	Significance	MDC/DWM Priority Quabbin Reservoir Watershed	MDC/DWM Priority Ware River Watershed
Agriculture	The recent Agricultural BMP Study and associated inventory identified sites in both watersheds including crops, hay, and livestock.	Crops and hayfields may involve use of pesticides and herbicides, which are of general concern, and fertilizers, which contain nutrients. Animal stabling or grazing sites can be sources of pathogens, coliform bacteria.	Crops and hayfields are of moderate concern; pesticides now in use are regulated and generally do not persist in the open environment. Buffer zones mitigate potential impacts. Fertilizers are of moderate concern, given the importance of keeping phosphorus loads to the reservoir low. Animal sites are high concern, due to potential transmission of waterborne pathogens.	Low Priority	Medium Priority
Highways, Railways, and Utility Rights-of-Way	Several highways and a railway are close to the reservoir. Drainage from these facilities currently reaches the reservoir.	Runoff from roads typically includes sediment, nutrients, metals, and oil. An accident on these roads and railway could introduce chemicals or fuels to the reservoir.	The roads and highway proximate to the reservoir are significant for potential spills. DWM monitors YOPs.	Medium Priority (Respond to all significant spills.)	Medium Priority

Potential Source of Water Contamination	Prevalence	Water Quality Concerns	Significance	MDC/DWM Priority Quabbin Reservoir Watershed	MDC/DWM Priority Ware River Watershed
On-Site Septic Systems	There are isolated problems in the watersheds.	Total and fecal coliform bacteria; viruses; and other pathogens. Nutrients especially nitrate.	Failing systems can be a source of coliform and possibly pathogens, while properly operating systems pose little risk. Areas of dense development may introduce nitrogen via groundwater.	Medium Priority	Medium Priority
Wildlife – Aquatic Mammals	Wildlife surveys are conducted in the watersheds showing shifting populations.	Beaver and muskrat can introduce pathogens into the water.	Beaver and muskrat outside the MDC/DWM's Aquatic Wildlife Pathogen Control Zone are probably of moderate concern.	High Priority (in AWPCZ)	Low Priority
Wildlife – Birds	Quabbin Reservoir is attractive to roosting gulls and geese; without control, bird populations would be significant.	Birds introduce fecal matter directly to the water, increasing coliform levels. Birds may also carry other bacteria (e.g., salmonella) and viruses, which may/may not be transmissible to humans.	The gull control program (including Canada goose controls) has been extremely successful, to the point where this source has very limited impact. The source would be significant to water quality, however, if the controls were relaxed.	High Priority	Low Priority
Local Land Use Activities	The watersheds remain relatively rural. The majority of new construction is single family residential.	Local land uses/activities are mainly development of new residential housing. Potential pollutants are sediment, nutrients, and oil/gas.	The WsPA has provided an important land use control to DWM. The major goal is to minimize the cumulative impact of residential development.	Low Priority	Medium Priority

Potential Source of Water Contamination	Prevalence	Water Quality Concerns	Significance	MDC/DWM Priority Quabbin Reservoir Watershed	MDC/DWM Priority Ware River Watershed
Recreation	Public access is allowed on a portion of MDC/DWM holdings with general and specific restrictions. Authorized activities are based on a detailed studies supplemented by water quality monitoring.	MDC/DWM's recreation studies showed a range of potential pollutants from erosion/sedimentation to pathogens, if human or animal (e.g., dog, horse, etc.) contact water.	Public access on MDC/DWM lands is limited to minimize risk of adverse impacts through the implementation of the Public Access Management plans, Interpretative Services, and the MDC/DWM Watershed Ranger Program. Efforts at controlling unauthorized activities should focus on reducing the threat of microbiological contamination.	High Priority (see Public Access Management Plans and Watershed Ranger Program)	High Priority (see Public Access Management Plans and Watershed Ranger Program)
Stormwater	Stormwater is a pollutant transport mechanism throughout the watersheds.	Stormwater (runoff) can contain a range of different pollutants, depending on the conditions of the contributing drainage area.	Stormwater can be controlled by a combination of source controls and treatment. Stormwater treatment is important where sources are diffuse or difficult to change (e.g., urbanized development without specific site problems), and benefits emergency spill protection.	Medium Priority	Medium Priority
Erosion	Erosion occurs primarily in places of soil disturbance, such as roads and new development.	Eroded soil brings nutrients and possibly metals and oils adhered to the soil particles.	Natural erosion is limited. Roads and construction sites require ongoing attention to reduce erosion or the possibility of future erosion. MDC/DWM has allocated resources to maintain MDC/DWM roads.	Medium Priority	Medium Priority

Potential Source of Water Contamination	Prevalence	Water Quality Concerns	Significance	MDC/DWM Priority Quabbin Reservoir Watershed	MDC/DWM Priority Ware River Watershed
Private Forestry (private logging)	There is private forestry activity in both watersheds.	Forestry activity can have minimal influence on water quality if conducted properly. Poor sites can introduce sediments, nutrients, and possibly oil/grease to waterways and/or physically damage streams and wetlands.	Overall, the presence of private forested lands has a positive benefit to the watersheds. It is important to ensure that forestry activity is conducted in keeping with state required and DWM recommended practices.	Low Priority (as long as activity is conducted under the Forest Cutting Practices Act)	Low Priority (as long as activity is conducted under the Forest Cutting Practices Act)
State Regulated Sites/Activities	DWM has worked with DEP to identify all significant sites, under Groundwater Discharge program, MCP., etc.	Generally, these sites could contain a range of different chemicals, oils, and petroleum products.	Due to their location and the fact that they are permitted and regularly inspected, few of these pose a risk.	Medium Priority	Medium Priority
Unauthorized Activities	Sporadic dumping occurs in the watersheds. Illegal activities which vary in intensity and include activities such as illegal swimming, ATV access, dog walking, and horseback riding are monitored.	Any contaminate present in the dumped material. Any contaminate introduced or transmitted by unauthorized activities.	On a relative basis, unauthorized activities appears to vary depending on location, time, and season.	Medium Priority (not common, but could be a potential threat)	Medium Priority (not common, but could be a potential threat)

Source: (MDC/DWM, Quabbin Section, 2000)

Table 3-5

Potential Contamination Source and Control Programs in the Updated Plan

Potential Source of Contamination	DWM's 2000 Priority Quabbin Reservoir Watershed	DWM's 2000 Priority Ware River	4.1 MDC/DWM Land Acquisition Program	4.2 Management of MDC/DWM Lands	4.3 Public Access	4.4 Addl. Protected Lands	5.1 Watershed Protection Regulations	5.2 Major Env. Regs.	5.3 Community Technical Assistance	5.4 Public Education	6.1 Wildlife	6.2 Agricultural Practices	6.3 Wastewater	6.4 Stormwater	7.1 Highways, Railways, & Utility ROWs	7.2 Indiv. Sites	7.3 Emergency Planning & Response	7.4 Construction Sites	8.1 WQ Monitoring	8.2 Flows	8.3 Sanitary Surveys
On-Site Septic Systems	H	H						✓	✓	✓			✓						✓		✓
Wildlife																					
▪ Birds	H	L									✓								✓		✓
▪ Aquatic Mammals	H	L									✓								✓		
Agriculture																					
▪ Chemicals	M	M	✓	✓		✓	✓					✓							✓	✓	✓
▪ Livestock & Crops	H	M	✓	✓		✓	✓					✓							✓	✓	✓
Recreation	M	H	✓	✓	✓	✓			✓	✓											
Storm water	M	M	✓	✓		✓	✓	✓	✓			✓		✓	✓		✓	✓	✓	✓	✓
Unauthorized Activities	L	M	✓	✓	✓	✓		✓	✓	✓											
Private Forestry (Logging)	L	M	✓	✓		✓															
Highways, Railways, Utility ROWs																					
▪ Herbicide Use	M	M													✓						
▪ Road Salting	L	L							✓					✓	✓						
▪ Uncontrolled Releases – Transp.	H	L						✓						✓	✓		✓				
Local Land Uses/Activities																					
▪ Construction	M	M	✓	✓		✓	✓	✓	✓	✓								✓	✓	✓	✓
▪ Gravel Mining	L	M	✓	✓		✓	✓	✓	✓	✓								✓			
▪ Future Development	M	M	✓	✓		✓	✓	✓	✓	✓								✓			

Potential Source of Contamination	DWM's 2000 Priority Quabbin Reservoir Watershed	DWM's 2000 Priority Ware River	4.1 MDC/DWM Land Acquisition Program	4.2 Management of MDC/DWM Lands	4.3 Public Access	4.4 Addl. Protected Lands	5.1 Watershed Protection Regulations	5.2 Major Env. Regs.	5.3 Community Technical Assistance	5.4 Public Education	6.1 Wildlife	6.2 Agricultural Practices	6.3 Wastewater	6.4 Stormwater	7.1 Highways, Railways, & Utility ROWs	7.2 Indiv. Sites	7.3 Emergency Planning & Response	7.4 Construction Sites	8.1 WQ Monitoring	8.2 Flows	8.3 Sanitary Surveys
State Regulated Sites/Activities																					
▪ Gas/Petroleum Storage	L	M				✓	✓	✓								✓	✓				✓
▪ Permit. – Solid Waste Facilities	L	M				✓	✓	✓								✓	✓				✓
▪ Permit.– Haz. Waste Generators	L	M				✓	✓	✓								✓	✓				✓
▪ Permit. – NPDES/GW Discharges	L	M				✓	✓	✓								✓	✓				✓
▪ Uncont. Releases – Fixed Site	L	L				✓	✓	✓								✓	✓				✓
Erosion	L	M	✓	✓	✓	✓	✓							✓	✓			✓			✓

Source: (MDC/DWM, 2000)

Section 4
Protected Lands

A major tenet of watershed management is protection through ownership of watershed lands. Owning and managing forest lands surrounding a public drinking water supply source is recognized as the most direct and proven method of protecting the water source's long-term quality:

- A forested watershed provides the best quality water.
- The purchase of undeveloped lands prevents its development; development can alter vegetation and drainage and introduce impervious areas and pollutants.
- The purchase of vegetated buffers provides natural "treatment" or protection to reduce water quality impacts of future development.
- The purchase of problem properties effectively halts the problem activity or use, and ensures proper clean up or revegetation of the site.
- Active management of watershed lands through proper forestry practices improves their pollution attenuation ability while reducing fire risk.

DWM owns the most sensitive, high risk lands within its three watersheds. Sensitive lands are defined as the lands directly surrounding the reservoir, in close proximity to the shoreline, and lands within 400 feet of tributaries to the reservoir). The total percentage of Quabbin Reservoir watershed lands (excluding the reservoir surface area), which are protected from development by all sources is 75%. Of the 75%, MDC/DWM owns 57% or 54,203 acres within the watershed; with 17,369 acres of other public or private lands comprising the balance. The Ware River watershed is now 57% protected and preserved with MDC/DWM ownership at 37% or 22,838 acres (up from 19,300 acres in 1985) (**Section 4.4**). In addition to land owned through direct ownership (i.e., fee simple), MDC/DWM also protects watershed lands from development through acquisition of conservation restrictions (CRs). MDC/DWM now owns 609 acres of CRs in the Quabbin Reservoir watershed and 478 acres of CRs in the Ware River watershed.

DWM's land acquisition program is guided by a series of land acquisition and management plans developed over the years. More detailed information is available in these plans, and copies are available from the MDC/DWM, upon request.

This section describes how DWM protects the watershed lands and waters by continuing to acquire additional sensitive lands (**Section 4.1**), managing MDC/DWM land cover for water quality protection (**Section 4.2**), and restricting public access and use (**Section 4.3**) on water supply lands and waters. This section also details the benefit provided by additional protected lands that are owned by other state agencies, conservation organizations, and private entities (**Section 4.4**).

Examples of MDC/DWM Management Plans:

- *MDC Land Acquisition Plan for Wachusett, Quabbin, Ware River, and Sudbury Watersheds: 1998-2000.*
- *MDC/DWM Land Management Plan Update, Wachusett Reservoir Watershed – 2000-2009.*
- *MDC/DWM Land Management Plan Update, Quabbin Reservoir Watershed – 1995-2004*
- *MDC/DWM Land Management Plan, Ware River Watershed (in progress as of 12/00)*

4.1 MDC/DWM Land Acquisition Program

Accomplishments:

- DWM and MWRA have been successful in obtaining funds to purchase watershed lands.
- Through several mechanisms, including the Open Space Bond Acquisitions, Land Acquisition Plan, and WsPA, the DWM has acquired high priority, high-risk lands, now owning approximately 57% of the Quabbin Reservoir watershed (excluding reservoir surface area) and 37% of the Ware River watershed.
- DWM and MWRA established the Land Acquisition Policy Panel to set relative priorities for land acquisitions. Following the successfully implemented land acquisition model developed for the Wachusett Reservoir watershed, a similar Ware River Watershed Acquisition Model was designed in 1998 with assistance from faculty of the University of Massachusetts Department of Natural Resource Conservation.

Assessment:

- MDC/DWM has acquired 1,343 acres in the Quabbin Reservoir watershed since 1991. The 1991 Land Acquisition Plan had called for a total of 1,020 acres to be acquired.
- MDC/DWM has acquired 3,031 acres in the Ware River watershed in the same time period. The 1991 Land Acquisition Plan had projected 8,097 acres to be purchased. This difference is due to two factors: a) the allocation of most land acquisition resources to the Wachusett Reservoir watershed since 1995, as a result of filtration waiver efforts; and b) an ongoing re-evaluation of the relative importance of the Ware River land acquisition, via the recent modeling effort and Land Acquisition Policy Panel deliberations.

Key Activities:

- Maximize long-term water quality benefit by acquiring and protecting sensitive watershed lands and continuing thereafter with additional purchases throughout three watersheds.
- Continue to utilize the Ware River Watershed Land Acquisition Model and other information along with the advice from the Land Acquisition Policy Panel to establish priorities for land acquisition.
- Continue to benefit from the expertise of the MDC Office of the General Counsel in appraising, engineering, and negotiating purchases.
- Pursue conservation restrictions on key open space parcels.
- Continue pilot programs of educating land owners regarding the tax benefits of donating conservation restrictions to local land trusts or government agencies, in order to protect lands within the MDC/DWM watersheds which aren't sensitive enough to warrant MDC/DWM acquisition.

4.1.1 Program to Date

4.1.1.1 History

When Wachusett Reservoir was completed in 1905, the Metropolitan Water and Sewer Board had purchased 4,100 acres of land to be flooded, and 5,600 acres of watershed land. When the Quabbin Reservoir was completed in 1939 and first filled in 1946, the Board purchased not only the lands required to create the impoundment, but a majority of the watershed. In addition, in the 1930's, 19,000 acres were purchased in the Ware River watershed. By the 1950's, MDC owned approximately 29,000 acres of flooded area and 78,000 acres of watershed, for a total of 107,000 acres (including the reservoir areas) of the combined Quabbin Reservoir/Ware River/Wachusett Reservoir watersheds.

From the 1950's to the mid-1980's, MDC sporadically acquired additional lands. Typically, such purchases were triggered only when a critical parcel was endangered by development.

4.1.1.2 Current Program and Accomplishments

The key driving forces behind DWM's formulation of an active watershed land acquisition program were the promulgation of the 1986 SDWA Amendments (including the SWTR) combined with another active building period in the 1980's in Massachusetts. The federal regulations highlighted the importance of land ownership and management of the watersheds of unfiltered sources and, at the same time, regional development pressure represented a current threat to critical watershed land. Together, these two factors caused MDC/DWM to focus on the need for a program to purchase and preserve additional land in watersheds in the 1980's. In 1983, MDC initiated its current watershed land acquisition program.

Funding

With support of the Administration, the Executive Office of Environmental Affairs (EOEA), and MWRA, MDC/DWM has been very successful in obtaining funds to purchase watershed lands. The MDC/DWM Watershed Land Acquisition Program was funded through three bonds and a fiscal year budget allocation: Commonwealth open space bonds (established in 1983 and 1987) of $3 million and $30 million dollars respectively, a $135 million bond established by the WsPA of 1992, and a FY1998 budget allocation of $16 million. MDC/DWM is authorized to spend $8 million per year of the WsPA funding. MWRA reimburses the Commonwealth for the debt service payments on WsPA bond purchases, and for all Payments in Lieu of Taxes (PILOT payments).

Purchase Approach

DWM uses a combination of fee simple acquisition, acquisition with tenancy or lease for continued, limited use, and conservation restrictions to obtain ownership rights. DWM acquisitions are typically consensual, (i.e., "friendly takings"), where the landowner agrees to the acquisition and price, and then MDC/DWM acquires the land by eminent domain[1].

As part of the acquisition process, DWM Environmental Quality (EQ) and Natural Resources (NR) land acquisition staff conduct an environmental assessment of each parcel. The assessment identifies any previous facilities or activities, such as auto garages and oil spills–which are unlikely in the Quabbin Reservoir or Ware River watersheds–that could indicate a need for action under the Massachusetts Contingency Plan (MCP) regulations or affect the property value.

Since the 1980's, DWM has conducted various analyses to select properties for acquisition and to evaluate forest management practices for water quality impacts (see plans listed above). The following sections present an overview of plans and reports produced to assist in setting priorities for expenditures from the above funding sources and the land purchased in each timeframe.

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[1] MDC's eminent domain power was restricted for watershed acquisitions by the WsPA and its later amendments. MDC cannot exercise eminent domain powers on land that is currently under a conservation restriction or classified under the M.G.L. Chapter 61 program (Forestland Tax Law), Chapter 61A program (Farmland Tax Law), or Chapter 61B program (Open Space or Recreations Lands Tax Law). On Chapter 61/61A/61B lands, MDC can only purchase land where there is a willing seller. However, if land is taken out of Chapter 61 classification by the owner, the WsPA requires towns to notify MDC, and MDC can choose to use its eminent domain powers.

Open Space Bond Acquisitions (1983-1993)

The 1983 open space bond of $3 million initiated the current land acquisition program. The 1987 Open Space Bond Issue (Section 3 of Chapter 564, Acts of 1987) established a $30 million account under the EOEA to purchase property in the Quabbin Reservoir, Ware River, Wachusett Reservoir, and Sudbury Reservoir watersheds for "the protection of the water resources of the Commonwealth". The Legislature delegated responsibility for expending these funds to the MDC/DWM and the Massachusetts Division of Fisheries and Wildlife (MDFW).

Drinking water supply protection is the first priority in the expenditure of these funds. Because MDFW's chief mandates are wildlife protection and enhancement, land which also protected water and wildlife has been chosen, where possible.

In setting land acquisition priorities, DWM and MDFW staff first defined a "water resources zone of influence" with the following criteria:

- Proximity to water supply intake structure,
- Proximity to surface water bodies,
- Degree of slope,
- Soil conditions,
- High rate of runoff,
- Local zoning designation, and
- Developability.

Within the water resources zone of influence, the following criteria (in order of importance) were used to prioritize parcels for acquisition:

1. Are presently threatened by development;
2. Contain a high degree of vulnerability to water resources degradation;
3. Represent rare and endangered plant or animal species habitat;
4. Provide excellent habitat for diverse species of fish, wildlife, and wild plants;
5. Abut existing MDC/DWM and MDFW property; and
6. Provide continuous corridors between other public or private conservation land.

DWM's Natural Resources staff used existing topographic, wetland, aquifer, zoning, flood plain, soil, and assessors maps to identify and map sensitive watershed land that met the above criteria. These criteria and the recommended lands to acquire were agreed upon and documented in a 1988 internal MDC/DWM document.

From FY1987 through FY1993, a total of $33 million was spent to purchase 8,670 acres. The key accomplishments of this acquisition period were holdings acquired along the East Branch of the Ware River within the Ware River watershed, the West Branch of the Swift River within the Quabbin Reservoir watershed, and the lower Stillwater River within the Wachusett Reservoir watershed.

Land Acquisition Plan (1991)

MDC and MWRA completed WPPs for Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds in 1991 (MDC and MWRA, 1991a & b). The plans were developed to aid the programs of the growing DWM, and to prepare for MWRA's possible application for filtration waivers[2]. Land acquisition was a critical part of these plans. DWM had already become more interested in acquisition since controlling or owning watershed land was an important element of the watershed protection requirements for receiving a MA DEP filtration waiver at Quabbin Reservoir's CVA.

Therefore, MDC completed an extensive land evaluation within the three active watersheds. Using the same maps from the original 1988 report, DWM applied additional criteria to more closely follow DEP guidelines (DEP, 1990). DEP policy defined priority zones for protection: Zone A - the area that falls within 400 feet of the 100-year floodplain of all Class A tributaries and Zone B – the area located one-half mile upgradient from the Zone A boundary. Due to the watersheds' sizes, DWM further defined Regions 1 and 2, with Region 1 representing more sensitive watershed land near the aqueduct intakes. Thus, the following priorities were used in the evaluation:

1. Land in Zone A-1;

2. Land in Zone A-2 that contains important tributary wetlands and aquifers;

3. Land in Zones B-1 and B-2 where significant development is possible and, due to the natural pollution-buffering capacity of the tributary (soils, wetlands, gradient, etc.), where there is greater concern for potential impacts on the water quality at the tributary outflow;

4. Land in Zones B-1 and B-2 adjacent to existing development which are important in filtering nonpoint urban runoff;

5. Land adjacent to MDC/DWM and/or MDFW holdings that will improve efficiency of land management activities (*e.g.*, boundaries, access, maintenance, forest management), which also meet one of the above criteria; and

6. Land valuable for wildlife habitat, scenic amenities, and open space, which also meet one of criteria 1-4.

Based on the updated analysis, the 1991 Plan recommended significant additional purchases, as shown in **Table 4-1**.

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[2] MWRA applied for and received a waiver of the filtration requirement for the CVA system served directly from Quabbin Reservoir. MWRA and MDC submitted an application for a waiver of the filtration requirement for the Metropolitan Boston system, served by Quabbin and Wachusett, in November 1998.

Table 4-1

Recommended Acquisitions in the 1991 MDC/DWM Watershed Protection Plans Quabbin Reservoir, Ware River, and Wachusett Reservoir Watersheds

MDC/DWM Watershed	*Acres to be Purchased over Long Term*	*Estimated Cost (millions of dollars)*	*Acres Purchased Since 1991 WPP (FY1991-Oct FY 00)*	*Actual Cost (millions of dollars)*
Wachusett Reservoir	10,500	$46.2	10,263[1]	$74.1
Quabbin Reservoir	1,020	$1.6	1,343	$3.4
Ware River	8,097	$13.6	3,031	$11.4
Total	**19,617**	**$61.4**	**14,637**	**$88.9**

Source: (MDC/DWM-NR, 2000)

[1] Contains acquisitions through Oct FY00.

Watershed Protection Act (WsPA) Acquisitions (1993-present)

After the completion of Open Space Bond spending in FY1993, DWM continued to acquire watershed lands following its 1991 Plan, with funding provided by Chapter 36 of the Acts of 1992, the Watershed Protection Act (WsPA). The WsPA authorizes land acquisition using the act's $135 million bond at the rate of $8 million/year, and requires such purchases to be consistent with procedures and priorities adopted by the Division or Commission. The WsPA stipulated DWM consider the following (and any additional) factors in identifying land for acquisition:

1. Threat from development activities that endanger water supply water quality.
2. Vulnerability to contributing to water resources degradation, whether by reason of proximity to water supply intake structures, proximity to surface water bodies, or degree of slope as related to soil erosion and flooding, soil conditions, and runoff rates.
3. The protection of rare and endangered plant and animal species habitat.
4. The protection of habitat for diverse species of fish, wildlife, and wild plants.
5. Immediate proximity to property now owned by the Commonwealth for the purpose of said division or said commission.
6. Location as part of continuous corridors between public or private conservation lands.
7. Loss of market value by reason of the restrictions contained in this act.

DWM found that factors 1-6 were already included in its approach to identify and prioritize parcels, and thus continued its existing selection process. In response to factor 7 of the WsPA, DWM considered purchasing individual parcels that would not otherwise be prioritized.

Land Prioritization Model

As the monies authorized by the WsPA became available, it was important for DWM to be able to proceed efficiently with acquisitions. DWM determined it needed additional tools to identify and prioritize desired parcels. The Land Acquisition Policy Panel was formed in 1993 and is comprised of MDC/DWM, MDC/Office of General Council (OGC), and MWRA staff. As necessary, the Panel set out to review and modify the criteria for selecting and prioritizing parcels to be purchased on the three active watersheds (the Sudbury Reservoir Watershed being inactive).

Working with the Department of Forestry and Wildlife Management, University of Massachusetts – Amherst, DWM developed, in 1998, a Watershed Land Prioritization (WLP) Model for the Ware River watershed which is similar to the model in use for three years in the Wachusett Reservoir watershed. The Wachusett model initially relied on exponential-distance calculations to evaluate time-of-travel parameters; presently it uses three defined basins as a criteria weight multiplier. The Ware model takes this approach a step further by incorporating travel time calculations based on GIS hydrologic and topographical characteristics data. Staff from the MDC Natural Resources, Environmental Quality, and Environmental Planning sections, and the MWRA developed 14 criteria that are consistent with the WsPA, which are mapped and converted to digital data layers. In addition, five Ware River watershed sub-basins have been weighted as multipliers. **Table 4-2** lists the criteria and corresponding weights that are used by the model to rank watershed lands.

The criteria and zone weights are derived using the Analytical Hierarchy Process (AHP), which is a technique using pair wise comparisons of all combinations of criteria and complex matrix algebra to fairly represent expert judgements in weighting different criteria.

The model ranks lands using a land sensitivity index calculated by adding the overlapping weights of all criteria for a given parcel of land and multiplying the sum by the weight associated with the overlay basin in which that parcel falls.

Table 4-2

Criteria and Weights used in the Ware River Land Prioritization Model
Expert Choice Analysis: Relative Criteria Weights

Criteria		*Weight*
A.	Land within 400' of lakes and ponds	0.167
B.	0-200' buffers around "unmapped streams"	0.245
C.	200'-400' buffers around "unmapped streams"	0.100
D.	High-yield aquifers/gravel areas	0.067
E.	Willing-seller farmers (with animals)	0.107
F.	0-200' WsPA buffers	0.042
G.	200'-400' WsPA	0.034
H.	"Big Bang For Buck" (large, inexpensive parcels)	0.052
I.	8-15% slopes (areas with)	0.026
J.	15 + % slopes (areas with)	0.026
K.	Access control/boundary consolidation	0.068
L.	Acquisitions to correct environmental problems	0.027
M.	Proximity to Route 2	0.023
N.	Other watershed land	0.016
(Inconsistency ratio = 0.080; a ratio below 0.1 is preferred)		
Basin		*Weight*
1.	Parker Brook	0.337
2.	Burnshirt River/Canesto and Natty Pond Brooks	0.345
3.	East and West Branch of Ware River above the US Army Corps of Engineers Dam	0.108
4.	Mare Meadow Basin	0.035
5.	Ware River downstream of US Army Corps of Engineers Dam	0.175
(Inconsistency ratio = 0.126)		

Source: (MDC/DWM, 1998)

MDC/DWM's use of these land prioritization models assures the continued cost-effective acquisition of the most sensitive of thousands of watershed parcels by using the latest GIS geographic, causal relationship, time-of-travel data, and other information.

The Ware model has not yet been applied to parcel acquisitions due to the lower priority placed on land purchases in the Quabbin Reservoir watershed and Ware River watershed than the Wachusett reservoir watershed from 1993-2000. The resumption of the land acquisition program for these two watersheds is anticipated in FY2001.

The decision to not model the Quabbin Reservoir watershed at this time was made by the Land Acquisition Policy Panel (LAPP) in favor of prioritizing sub-basins only. The significantly high protection level on the Quabbin Reservoir watershed will result in a correspondingly lower level of land procurement activity, and less complicated land priority decisions.

The draft *MDC Land Acquisition Plan – Wachusett Reservoir, Quabbin Reservoir, Ware River, and Sudbury Reservoir Watersheds 1998-2000* (O'Connor, 1998) states that a re-examination of an estimated allocation of the remaining $90 million of land acquisition funds will be made after the completion of the Ware River and Quabbin Reservoir watershed models. This preliminary allocation assigns $21 million to the Ware River watershed and $4 million to the Quabbin Reservoir watershed. A refinement of these estimates and the implementation of these prioritization strategies (e.g., Ware model, Quabbin basin ranking) will begin in the FY01 land acquisition planning process.

Summary

Tables 4-3 and **4-4** summarize land acquisition spending and acres purchased for the fiscal years since the inception of this program. During FY1993, MDC spent the remaining 1987 bond monies and began spending the $135 million WsPA bond.

Table 4-3

MDC/DWM Land Acquisitions (1985-2000)
Quabbin Reservoir, Ware River, and Wachusett Reservoir Watersheds

Fiscal Year	*MDC/DWM Purchases*			*Subtotal MDC (acres)*	*Total MDC & MDFW (acres)*	*Total Cost*[1] *($M)*
	Wachusett (acres)	*Quabbin (acres)*	*Ware River (acres)*			
1985	51			51	51	.058[2]
1986						
1987	79	292	271	642	642	1.150
1988	24	77		101	101	.471
1989	498	105	107	710	710	6.006
1990	327	594	129	1,050	2,119	7.028 (4.600 MDC only)
1991	586	346	1,057	1,989	3,425	9.576 (6.400 MDC only)
1992	338	203	202	743	941	4.349 (3.800 MDC only)
1993	554	134	817	1,505	1,505	7.100
1994	820	410	632	1,862	1,862	8.356
1995	998	137	211	1,346	1,346	7.764[3]
1996	1,479	113	1	1,593	1,593	14.003
1997	1,668		5	1,673	1,673	13.679
1998	2,002		106	2,108	2,108	10.138
1999	888		106	888	888	8.000
2000	874		106	874	874	6.773
Total	**11,186**	**2,411**	**3,750**	**17,135**	**19,838**	**104,451** **(98,298 MDC only[4])**

Source: (MDC/DWM-NR, 2000)

[1] All costs are in millions of dollars and include ancillary costs (survey, title, appraisal)

[2] Reflects $3 million 1983 bond issue - which was used to purchase 927 acres from FY1985-89

[3] Does not include taxes and interest costs for FY1994 and 1995

[4] MDFW acquired 2,703 acres on the three watersheds during FY1990-2 at a cost of $6.153 million.

Table 4-4

MDC/DWM Land Holdings in 1985 and 1999[1]
Quabbin Reservoir, Ware River, and Wachusett Reservoir Watersheds

	MDC-Owned Land, 1985		*MDC-Owned Land, 1999*	
Watershed	*Acres*	*Percent of Watershed*	*Acres*	*Percent of Watershed*
Wachusett Reservoir	5,608	7.9	18,700 [2]	26.3
Quabbin Reservoir	51,792	54.3	54,203	56.8
Ware River	19,300	31.3	22,838	37.0
Total	**76,700**	**33.7**	**95,741**	**41.8**

Source: (MDC/DWM-GIS, 2000)

[1] Figures from MDC GIS and other sources. Watershed totals do not include reservoir surfaces. MDC land outside of watershed boundaries is not included. Figures are current to date of report.

[2] Includes 2,164 acres that are owned by DEM and under MDC control via an executed care and control agreement.

Overall, MDC has made great progress towards the land acquisition goals in the original 1988 study and the 1991 Plans. In fact, DWM has either reached or is ahead of schedule on each goal. From FY1991 to FY1999, MDC acquired 8,332 acres and executed a care and control agreement with DEM for 2,164 acres in the Wachusett Reservoir watershed, for more than 10,500 acres recommended in the 1991 plan as a long-term goal. A total of 4,374 acres was purchased on the Quabbin Reservoir and Ware River watersheds during this same period (most between 1991 and 1996). Specifically, 3,031 acres were acquired on the Ware River watershed, and 1,343 acres on the Quabbin Reservoir watershed.

4.1.2 Assessment

With support from the MWRA and the state, DWM now has major land holdings in the three active watersheds and the most critical lands in each. These owned lands contribute to effective protection of the drinking water supplies. **Figure 2-3**, presented previously, shows the MDC-owned lands in the three watersheds.

4.1.3 Control Approach

4.1.3.1 Goals

After FY2000, the long-term goal is to make acquisitions in sensitive areas of all three watersheds, with continued focus on the Wachusett Reservoir watershed. Preliminary planning estimates that approximately two-thirds of the funding after FY2000 will be used for acquisitions made in Wachusett Reservoir watershed. The remaining third will be allocated to acquisitions on the Quabbin Reservoir and Ware River watersheds. These acquisitions throughout the entire watershed system will provide long-term water quality protection by establishing stable forest cover, and by reducing long-term development potential.

4.1.3.2 Five-Year Objectives

DWM has identified specific objectives for the coming five-year period.

1. Maintain the existing, efficient methods and processes for acquiring land (including MDC Office of the General Counsel assistance).

2. Continue to acquire lands for all three watersheds with the $8 million/year open space funds.

4.1.3.3 Activities

1. Continue to conduct the Land Acquisition Program and acquire lands in the three watersheds. Generally 5% of funds are projected to be applied to Quabbin, 22% to Ware, and 73% to Wachusett. The allocation is subject to change, based on the annual budget, GIS models, and guidance from the Land Acquisition Policy Panel.

2. Utilize the MDC/DWM's Land Acquisition Models and continue to update any pertinent data that can serve to refine the priority schemes on the Ware River and Quabbin Reservoir watersheds. Continue to ground check with site walks and incorporate advice from the Land Acquisition Policy Panel to set priorities for acquisitions. Continue to use the services of the MDC Office of the General Counsel to complete survey, title, engineering, and negotiation activities for new parcels.

4.2 Management of MDC/DWM Lands (including Forestry)

Accomplishments:

- MDC/DWM made Payments in Lieu of Taxes (PILOT) to 30 communities in the Quabbin Reservoir, Ware River, Wachusett Reservoir and Sudbury Reservoir watersheds to compensate municipalities for "lost property taxes." Since 1992, $24.3 million has been distributed, including $3.1 million in FY2000. The program is funded by the MWRA.
- MDC/DWM established professional forestry staff at Quabbin Reservoir and Ware River watersheds to plan and manage forests to improve long-term water quality protection.
- MDC/DWM completed its Quabbin Land Management Plan 1995-2000 and 2000-2005. DWM staff are now implementing the Quabbin Land Management Plan 2000-2005 to improve current regeneration and to establish a diverse and stable, multi-layered forest cover on its water supply lands.
- MDC/DWM conducts active silviculture on Quabbin Reservoir and Ware River watersheds to effectively maintain healthy and diverse forests.
- The Rainforest Alliance's Smart Wood Program evaluated the MDC/DWM's management of the Quabbin Reservoir watershed forest in 1997, and granted it "green certified" status.
- DWM's silviculture practices supplement strict forestry Best Management Practices (BMPs) required by the Massachusetts Forest Cutting Practices Act.
- DWM has reduced white-tailed deer population densities and enhanced tree regeneration within Quabbin Reservation through implementation of the White-tailed Deer Impact Management Program.
- Maintenance of Continuous Forest Inventory (CFI) within the Quabbin Reservoir and Ware River watersheds since 1960.
- Implementation of routine tree regeneration surveys throughout Quabbin Reservation since the late 1980's.
- Integration of forest sampling prior to any commercial timber harvest by MDC/DWM Foresters.
- Annual Spring browse surveys within the Quabbin Reservation to monitor growth of sprout hardwoods.
- Use of more technically sophisticated harvesting equipment.

Assessment:

- The majority of the Quabbin Reservoir and Ware River watershed forests are over 60 years old, and originate from turn of the century farm abandonment, MDC plantings during the 1930's and 1940's, and natural regeneration following the Hurricane of 1938.
- The 78,000 acres of MDC/DWM managed forests and fields provide a significant level of long-term water quality protection to the Quabbin Reservoir and Ware River intake.

Key Activities:

- Continue to conduct silviculture activities with the goal of forest diversity. Continue inspections to ensure compliance with DWM's BMP requirements for water quality protection.
- Develop and implement the Ware River Land Management Plan, including approaches for newly acquired lands, management of open areas and forestry.
- Continue to implement and assess the Quabbin Reservation White-tailed Deer Impact Management Program.
- Continue routine forest monitoring by all MDC/DWM foresters.
- Complete CFI 2000.
- Continue data collection for and analysis of tree regeneration surveys and browse surveys.

4.2.1 Program to Date

4.2.1.1 History

MDC has always managed its lands for water quality benefit. Even when each reservoir was being constructed, land to be flooded was cleared of any buildings and grubbed to remove nutrients contained in vegetation. Between 1935 and 1944, 12 million trees were planted around the Quabbin Reservoir and Ware River watersheds to reforest treeless farmland. Red pine was the preferred species, along with White pine, Norway spruce, White spruce, Black spruce, European larch and Eastern hemlock. The development of the MDC tree nurseries and planting programs were under the control of a professional forester. The first forest thinning activities were conducted in the 1950's and have continued to the present. These plantations are currently being converted to native species, both hardwoods and white pine as soon as regeneration develops in the understory. From the date of purchase of these lands up to 1960, little harvesting in the natural forest took place except for the salvage of storm damaged timber and timber removal to meet MDC's needs. Salvage following the 1938 hurricane was limited due to a vast oversupply of logs. Consequently only 15%-20% of the damaged timber was salvaged. Great efforts were made to cut the hurricane slash to reduce the fire danger on much of the MDC lands.

In 1960, MDC Chief Forester Fred Hunt prepared the first management plan for the Quabbin Reservation, an area immediately surrounding the reservoir and bounded by the major roadways. This detailed plan was developed from the information provided by the Continuous Forest Inventory (CFI) survey of the MDC lands in the Quabbin Reservoir watershed. It proposed a silvicultural basis through which to manage the forest for the production of quality water, the continuous improvement of the quality of the timber being grown, maintenance of wildlife habitats and attention to forest aesthetics. All subsequent plans written in the 70's, 80's and 90's have followed a similar approach in the management of these lands. From a single professional in 1960 who was responsible for the management of all MDC watershed lands (90,000 acres) the DWM has added foresters to all watersheds for a current total of 8 foresters working on over 100,000 acres.

Since the 1960's the DWM's Quabbin Reservoir and Ware River watershed forests have been managed using state-of-the-art silvicultural practices to maintain the watershed protection function of these forests. This has consisted of thinnings to improve stand composition and growth and harvest operations to regenerate areas from a single tree opening up to several acres. These operations are part of a long-range program aimed at increasing the diversity, nutrient assimilation, resiliency and filtering capacity of this "protection forest". To date most of the Quabbin Reservoir and Ware River watershed lands have been silviculturally treated through 1143 timber sale permits and over 100 salvage sales.

Continuous Forestry Inventory

In order to control and direct forest management activities on MDC/DWM's watershed lands, information about the forest is necessary. In 1960, the MDC/DWM initiated the Continuous Forest Inventory (CFI) to collect such information within both the Quabbin Reservoir watershed and the Ware River watershed. CFI requires the establishment of permanent 1/5 acre plots systematically placed throughout MDC/DWM lands. These CFI plots are inventoried every ten years to record various measurements on all trees with a diameter at breast height (dbh) which is greater than 5 inches. Data is also collected from trees with a dbh which is less than 5 inches. The CFI provides foresters with information on the relative diversity of the forest, information regarding the forest stand, as well as information regarding individual trees within the stand. Additional information collected within the plot includes both natural and human disturbances. Over time, these plots record change expressed in many different ways – growth, development, diversity – on a forest wide basis.

In the late 1980's, MDC/DWM staff conducted a tree regeneration survey throughout the Quabbin Reservation. The Quabbin Reservation is MDC/DWM controlled land that falls within the major highways surrounding the Quabbin Reservoir, is contiguous to the reservoir, and was part of the General Taking in the

1930's. The purpose of the survey was to document the impact of a very large deer population on the regrowth of seedlings and samplings up to 4.5 inches tall. The results of MDC/DWM's survey indicated that in locations where deer had not been hunted (Quabbin Reservation), the deer had prevented the growth and development of both seedlings and saplings of all species. MDC/DWM staff has continued to monitor seedling and sapling growth since the controlled deer hunt within select areas of the Quabbin Reservation began in 1991. In addition to conducting these regeneration surveys, MDC/DWM staff conduct browse surveys in the Spring throughout the Reservation. These surveys are conducted on recently harvested hardwood forest stands to monitor the growth of sprout hardwoods.

4.2.1.2 Current Program and Accomplishments

MDC/DWM-owned lands include forests, shoreline areas, fields, administrative areas, and buildings. While land management practices historically focused on forestry, new responsibilities have been added to the task of managing MDC lands in recent years. These include tasks associated with the land acquisition program since it began in 1970 and with other recent MDC initiated activities, such as wildlife habitat manipulation and public access controls. These activities are described below under five categories: Ownership Policies, Management of New Acquisitions, Management of Non-Forested Lands, Silviculture (Forestry), and the Quabbin Reservation White-tailed Deer Impact Management Program.

MDC/DWM's current and planned land management program in the Quabbin Reservoir Watershed is detailed in the *Quabbin Land Management Plan 1995-2004.* This Plan requires MDC/DWM Foresters to sample the forest stocking conditions prior to marking areas for a commercial timber harvest. This data helps the foresters prepare a silvicultural prescription, and also provides important records of stocking levels before and after the harvest. This information is kept with each timber sale file. The *MDC/DWM Ware River Land Management Plan* is currently under development. Providing the best possible land cover for the protection of tributary water quality throughout the watersheds is the MDC/DWM's primary focus in its Land Management Plans. The preponderance of forest cover surrounding the Quabbin Reservoir is reflected in the plan's emphasis on forest management activities. The most important goal for the Land Management Plan is to maintain the function of this watershed protection forest in both the short term (10 years) and long term (60 years).

Ownership Policies

Payments in Lieu of Taxes (PILOT payments): The Legislature established Payments in Lieu of Taxes to compensate municipalities for "lost" property taxes when a state agency purchases land, since the State is exempt from municipal tax. Specific legislation, M.G.L. Ch. 59, § 5G, was adopted to address MDC/DWM property. For all other State owned land, the Commonwealth makes PILOT payments through the annual local community aid (the "cherry sheet"). The MDC/DWM PILOT program has the Division pay the communities directly, with funds provided by the MWRA.

PILOT payments are made to 30 communities in the Quabbin Reservoir, Ware River, Wachusett Reservoir and Sudbury Reservoir watersheds. $24.3 million has been distributed since 1992, including $3.1 million in FY2000. PILOT disbursements in FY2000 for the Quabbin Reservoir and Ware River watershed communities of Barre, Belchertown, Hardwick, Hubbardston, New Salem, Oakham, Orange, Pelham, Petersham, Phillipston, Rutland, Shutesbury, Templeton, Ware, and Wendell totaled $1,345,651 **(Table 4-5)**.

The PILOT amount is determined by multiplying the highest local tax rate by the property value, which is determined by the Department of Revenue. Thus, if a town has a commercial tax rate as well as a residential one, but an MDC/DWM acquisition is located in a residential zone, the higher commercial tax rate is used in the PILOT payment calculations. A key provision of the MDC/DWM PILOT program is that a community's annual payment can never be less than the previous year, even if tax rates or the land valuation decreases; however, the annual PILOT payment can be more than the previous year if the tax rates go up. The Department of Revenue revalues property once every five years, in years divisible by five. The latest revaluation was completed in June 2000; the new property values will take effect in FY2001. At the time of publication, all of the communities' tax rates were not yet set, however it is projected that the total PILOT figure will increase approximately 60%, to $4.9 million. This new amount reflects the large amounts of land acquired in the Wachusett Reservoir watershed and the increase in land values throughout the watershed system. It is estimated that the Quabbin Reservoir and Ware River watersheds' FY2001 PILOT will be over $2 million.

Table 4-5

MDC/DWM Payments in Lieu of Taxes FY2000 and FY2001

Quabbin Reservoir Watershed and Ware River Watershed

Watershed Community	PILOT FY2000	Projected PILOT FY2001	Projected Increase[1]
Barre	$105,565	$161,153	53%
Belchertown	$135,335	$170,426	26%
Hardwick	$53,667	$53,667	0%
Hubbardston	$118,933	$275,663	132%
New Salem	$201,740	$210,896	5%
Oakham	$70,466	$75,365	7%
Orange	$3,181	$3,181	0%
Pelham	$76,426	$1,227,427.24	104%
Petersham	$242,726.12333	$370,349.12	57%
Phillipston	$6,581	$6,581	0%
Rutland	$142,922	$256,815	80%
Shutesbury	$81,429	$235,514	189%
Templeton	$469	$469	0%
Ware	$302,280.59	$489,568.59	170%
Wendell	$16,029	$16,029	0%
Total	**$1,345,651**	**$2,269,443**	**69%**

Source: (MDC/DWM-EP, 2000)

[1] Projection uses FY2000 Tax Rates and June, 2000 DOR land revaluation figures.

Monitoring Conservation Restrictions: MDC/DWM currently owns over 1,000 acres of land in the Quabbin Reservoir watershed and Ware River watershed with conservation restrictions. MDC monitors these properties on a regular basis to ensure that the conditions set by these restrictions are achieved and maintained.

Article 97: MDC is held to EOEA Article 97 Land Disposition Policy (February 19, 1998). This policy establishes as a general rule that EOEA agencies shall not sell, transfer, lease, or change the control or use of any interest of the Commonwealth in its open space land. MDC cannot, without demonstrating exceptional circumstances and the lack of any other option, effect 1) any transfer of ownership or interest, 2) any change in physical or legal control, or 3) any change in use whether by deed, easement, or lease. A revocable permit is allowed as long as there is no transfer of interest in real property, and there is no change in use in conflict with the Agency's mission.

The MDC adopted its own land disposition policy for Division of Watershed Management lands on April 30, 1998. This policy further defines the exceptional circumstances that must be met and the procedures that must be followed. The policy is designed to help ensure that any potential disposition does not have an adverse impact on the Division of Watershed Management's statutory mandate to assure the availability of pure water for future generations and to protect, preserve and enhance the environment of the Commonwealth.

Management of New Acquisitions: As a result of the land acquisition program, MDC/DWM has many newly acquired parcels. For each new acquisition, DWM staff performs an initial assessment of the property, identification of any hazardous waste issues (including location of underground storage tanks), evaluation of forest stands, and decisions regarding demolition or maintenance of any structures on the parcel.

Management of Non-Forested Lands: MDC/DWM is responsible for management and maintenance of all its lands, including the shoreline areas, administrative areas, and fields, which do not fall under the Silviculture/Forestry program. In recent years, DWM has increased its use of different management techniques to aid related goals; for example, decreasing mowing frequency and keeping grass taller in key lawn areas along the shoreline to discourage Canada geese from nesting along the shoreline.

Silviculture (Forestry): To improve long-term water quality protection, DWM manages the structure of the forest cover on these watersheds using silviculture. Silviculture is the deliberate tending of the forest to control the stocking, composition, and growth which restructures age/size classes to benefit watershed protection or habitat diversity, among other objectives. Because trees have an economic value, this work is accomplished by professional logging contractors, who in turn pay for the permit to harvest measured volumes of forest products. Consequently, the management of the watershed lands to maintain the "protection forest" also generates income to defray DWM costs. Trees of low quality and vigor are removed in thinning operations and mature trees are removed in harvest cuts to regenerate new age classes. The managed, diverse forest will be more resistant and resilient to natural disturbances, such as wind storms or insect infestations. In particular, maintaining a component of young to middle-aged forest within the overall forest retains vigorous nutrient uptake, and preserves a reserve forest to immediately replace lost overstory trees.

The Rainforest Alliance's Smart Wood program evaluated MDC/DWM's management of the Quabbin forest in 1997, and granted it "green certified" status. Smart Wood is an internationally certified program that evaluates forest management operations for sustainability and state-of-the-art, forestry best management practices (BMPs). The MDC/DWM's Quabbin holding became the first public land in North America to achieve the status of "green certification," after an extensive independent evaluation by the team of Smart Wood experts. Part of the process involved comparing MDC/DWM's forestry BMPs to three other large water supply forests in the Northeast. MDC/DWM's forestry BMPs compared very favorably with those required by other water suppliers.

DWM's forest management program encompasses the following activities:

- New acquisitions – Compared to DWM's acquisition activity on the Wachusett Reservoir watershed, there have been relatively few new properties added to the Quabbin Reservoir and Ware River watersheds in recent years. When properties are added, they often abut existing MDC/DWM land, and are, therefore easily incorporated into normal operations. To monitor the condition of these new properties, new Continuous Forest Inventory plots are added as necessary. Boundary surveys are completed where these are required.

- Annual planning – Areas requiring silvicultural treatment are determined each year. The proposed silviculture is detailed in a project form that is accompanied by a detailed GIS map and submitted for approval through the MDC/DWM Internal Review Process. Through this process, proposed forestry activities are reviewed by Natural Resources staff for their potential impacts on wildlife and their compliance with existing regulations and management plans. In addition, MDC's staff archaeologist reviews these plans annually for their potential impact on cultural resources.

- Operations – Operations require the preparation of timber sale permits, maintenance of boundaries and access roads, monitoring of forest growth and development, monitoring of regeneration and browsing and conducting non-commercial silviculture with DWM personnel.

DWM conducts active silviculture on approximately 1,500 - 2,000 acres per year on the Quabbin Reservoir watershed, 500 - 1,000 acres on the Ware River watershed, and 200 - 500 acres on the Wachusett and Sudbury reservoir watersheds. Each of these figures represents about 2 - 3% of the MDC/DWM ownership per year. Of this 2-3%, about 50% involves regeneration operations to produce new age classes. For any given forest stand under management, the frequency of return trips to harvest again (the cutting cycle) seldom exceeds once every 15-30 years, after a diverse stand has been established.

While active management is beneficial for the long term, it is possible that harvesting activity could cause short-term problems. During 35 years of active silviculture on MDC watershed lands, no water quality degradation has been associated with these practices.

Potential water quality threats associated with silviculture on the MDC/DWM watersheds are primarily controlled through the implementation of BMPs specified by the Massachusetts Forest Cutting Practices Act and by additional DWM water quality specifications in timber harvesting permits (see **Table 4-6**). Applied carefully, forestry BMPs have been demonstrated to eliminate significant water quality threats associated with silviculture. A recent DEP tour of MDC/DWM forestry operations highlighted several watershed protection oriented activities. These activities included: 1) bridging of all streams; 2) use of slash for skid roads; and 3) use of small openings (e.g., single-tree or small group cuts) to promote regeneration while keeping the primary forest cover intake.

Forestry Best Management Practices (BMPs)

Forestry BMPs include specifications for erosion control in road and stream crossing designs, the maintenance of filter strips along water courses, limitations on equipment size and type, requirements for petroleum-absorbing pads to contain spills, and restrictions on logging when ground conditions will not support equipment.

DWM implements BMPs through its timber harvest permits and careful supervision by DWM forestry staff of operations on its own holdings.

During active timber harvesting operations, DWM foresters may visit operations as often as once a day, and both reserve and exercise the right to shut down operations either for non-compliance or due to extremes in weather that increase the risks of detrimental effects on water quality.

DWM forestry activities also include protecting the forest from wildfires, maintaining woods access roads (used for forest management, surveillance of public access, water sampling, and fire protection), and using BMPs.

Table 4-6

MA DEM (M.G.L. Chapter 132) and MDC/DWM Forestry BMPs

Item	*DEM*	*MDC/DWM*
Filter Strips	50 feet; variable width along streams >25 feet in width, ponds >10 acres in size and along Outstanding Resource Waters	Same, but also variable width along all streams, river and water bodies adjusted for soil drainage characteristics
Buffer Strips	50 feet; 100 feet along designated scenic roads	Same
Stream Crossings	Allows for the unbridged crossing of continuously flowing streams unless within 1,000 feet of a public water supply reservoir	All crossings of permanently flowing streams will be bridged
Wetlands	Allows machinery to operate on deep muck soils when dry or frozen conditions will support the equipment	No equipment allowed on muck soils
Vernal Pools	Regulations only apply to Certified vernal pools	Regulations and recommendations apply to all vernal pools
Logging Equipment	No regulations	Weight and width of equipment are restricted based on site conditions

Source: (MDC/DWM-Natural Resources, 2000)

Quabbin Reservation White-tailed Deer Impact Management Program

In 1991 MDC/DWM staff opened the Quabbin Reservation for limited, controlled public deer hunting, after more than 50 years of no hunting. This action was in response to growing concern about the impacts of deer browsing on forest regeneration and the potential long-term consequences of those impacts on water quality. Hunting has been conducted in the Quabbin Reservation each year since. The driving force behind the program has always been to reduce the impacts of deer browsing to a level that allows and promotes the development of a healthy, resilient, diverse forest that can adequately and continuously protect water quality. Major components of the deer population reduction program were to: 1.) Reduce population densities, and 2.) Maintain those densities at a level that allows for the continued growth and regeneration of forest tree species.

Water Quality Protection Measures: At the beginning of the program, in anticipation of a large number of hunters in a short amount of time in traditionally restricted areas, DWM implement three types of water quality protection measures: pathogen prevention, erosion control, and chemical spill protection. MDC/DWM conduct these control measures prior to, during, and following the Deer Impact Management Program. Prior to the controlled hunt, all selected hunters are required to attend an educational orientation session. This session explains in detail the relationship between activities on drinking water supply lands and waters and reservoir water quality protection. In addition, MDC/DWM details the location of portable toilets as well as the required use of a sanitation kit with gloves and hand wipes for harvesting deer and preventing use of tributaries. Hunt activities (e.g., gutting deer) are specifically prohibited within 100 feet of any tributary during the hunt. During the controlled hunt, all hunters are checked into and out of the MDC/DWM managed lands by MDC/DWM staff. During the hunt, the use of portable toilets and placement of the toilets are evaluated by EQ staff for future modifications. Following the hunt, DWM staff conduct surveys of popular hunt areas to evaluate the impacts of the hunt. Along with pathogen prevention measures, the DWM staff install erosion control measures, such as blocking roads from vehicle access and repairing necessary access roads prior to the hunt. DWM staff carry containment booms and pads for any chemical spills from possible vehicular accidents.

Hunter Effort and Participation: DWM staff divided Quabbin Reservation into five management blocks in 1991. These blocks represent distinct management units and include most of the Quabbin Reservation areas identified in regeneration surveys as having a reduced tree species component in the forest understory. The disturbed areas on Reservation lands averaged 1,613 stems per acre above one foot, and 240 stems per acre above deer browsing height. In comparison, traditionally hunted areas averaged 4,590 stems per acre above one foot and 1,840 stems per acre above deer browsing height.

Participants in the controlled hunts are chosen in a random lottery from a pool of licensed hunters submitting the required application form and fee to the MDC/DWM. The number of hunters applying for the hunt has varied from approximately 1,500 in 1999 to over 9,000 in 1992 (**Table 4-7**). The number of hunters chosen in any one year has varied, depending on the number of areas being hunted and the number of hunting segments per area. The number of hunters applying to the Quabbin hunts has dropped sharply since 1991, and unfortunately the number of hunters applying in 1999 was at an all time low. It is impossible to predict future trends in hunter interest, although statewide and regional trends would indicate that the hunter base is continuing to shrink.

Table 4-7

**Number of Hunters Applying and Selected for
MDC/DWM's White-tailed Deer Impact Management Program
Quabbin Reservation Deer Hunts 1991-1999**

Year	*# Hunters Applying*	*# Hunters Selected*
1991	7444	1020
1992	9503	2089
1993	7052	2303
1994	3418	2348
1995	4846	1702
1996	2742	1503
1997	1790	1525
1998	2086	1338
1999	1522	1311

Source: (MDC/DWM-Natural Resources, 2000)

Building on the success and lessons learned during the first few years of hunting, DWM staff steadily expanded the controlled hunting program after the first hunt, until all five blocks of the Quabbin Reservation were being hunted by 1994. However, since hunting effort in any one block decreased in succeeding years (as deer population density in that area declined), the overall program effort (e.g., number of hunters participating, or number of hunting segments) has steadily declined since that time (**Table 4-8**). Typically, when a new block was first opened to hunting, three "segments" (i.e., different groups of hunters assigned to separate 2- or 3-day hunting periods) were scheduled for that area. In succeeding years, this would be reduced to two. By 1996, only one hunting segment was scheduled for each of the five blocks, and by 1999, only one, 2-day hunting segment was used in each area.

Table 4-8

Hunting Effort During MDC/DWM's White-tailed Deer Impact Management Program Quabbin Reservation Deer Hunts 1991-1999

Year	*# Hunters Selected*	*# Acres Hunted*	*# Hunters/# Acres*	*# Areas Hunted*	*# Hunting Segments*
1991	1,020	9,000	.113	1	3
1992	2,089	21,400	.098	2	12
1993	2,303	31,800	.072	4	10
1994	2,348	40,400	.058	5	9
1995	1,702	38,960	.044	5	6
1996	1,503	40,400	.037	5	5
1997	1,525	40,400	.038	5	5
1998	1,338	35,700	.037	4	4
1999	1,331	40,400	.037[1]	5	5

Source: (MDC/WM Natural Resources, 2000)

[1] Only 1,311 hunters were initially selected for the 1999 hunt; 205 selected hunters were chosen to hunt Pelham in addition to their original hunting segment.

Harvest Results: Since 1991, approximately 13,000 hunters have harvested almost 3,400 deer from Quabbin Reservation (**Table 4-9**). Deer harvest results follow a similar pattern for all management blocks. When a block is initially hunted, harvest is quite high (up to 30-40 deer killed/mi^2). This initial reduction phase of the program may last for 2-3 years until deer densities reach lower levels. Following reduction, yearly harvest tends to stabilize with some year to year fluctuation (Table 4-10).

Results of the deer impact management program are encouraging. Regeneration continues to make progress, although species diversity is still lacking. The current *Quabbin Reservation 5-Year (2000-2004) White-Tailed Deer Management Plan* outlines a 5-year rotation as the foundation for management decisions over the next five years. Each year one of the five management blocks will not be hunted. Therefore, any one block will be hunted four out of five years. A simple annual review of the harvest, regeneration, and browse data will be done. If the data suggests that modifications need to be made to the hunting program, then appropriate changes will be made. Accurate harvest data will continue to be collected in order to track changes in herd characteristics.

Table 4-9

Results of MDC/DWM's White-tailed Deer Impact Management Program Deer Hunts on Quabbin Reservation by Year: 1991-1999

Year	*Total Deer Harvested*	*% Female*	*% Male*	*% A/L*[a]	*Deer/Mi^2 (killed)*	*# Hunters*	*Hunter Success*[b]	*Mi^2 Hunted*
1991	575	60.3	39.7	71.8	40.9	855	67.3	14.1
1992	724	54.0	46.0	60.5	21.7	1971	36.7	33.4
1993	474	62.0	38.0	67.1	9.5	2168	21.9	49.7
1994	673	59.9	40.1	68.9	10.7	2118	31.6	63.1
1995	284	64.8	35.2	74.3	4.7	1508	18.8	60.9
1996	129	58.1	41.9	67.4	2.0	1213	10.6	63.1
1997	293	62.1	37.9	73.4	4.8	1207	24.3	63.1
1998	123	57.7	42.3	65.9	2.3	1099	11.2	55.8
1999	112	39.3	60.7	51.8	1.8	1192	9.4	63.1
Overall	3387	57.6	42.4	66.8	-	13331	24.6	-

Source: (MDC/DWM - Natural Resources, 2000)

[a] A/L: antlerless; females and young males with antlers less than 3 inches long.

[b] Hunter success is the number of deer taken per 100 hunters. Some hunters took more than one deer, so these figures slightly overestimate the proportion of successful hunters.

Table 4-10

Results of MDC/DWM's Program on Quabbin Reservation by Block 1991-1999

Block Location	***Year***	***# Deer***	***Deer/Mi²ᵃ***	***Deer/Hunter***	***% Female***
Pelham	1991	575	40.9	.67	60.3
	1992	111	7.9	.12	56.8
	1993	58	4.1	.22	56.9
	1994	50	3.6	.20	46.0
	1995	28	2.4	.12	42.9
	1996	15	1.1	.05	66.7
	1997	48	4.0	.17	56.3
	1998	22	1.9	.08	68.2
	1999	20	1.7	.07	45.0
Prescott	1992	613	31.6	.58	53.5
	1993	168	8.7	.17	61.3
	1994	61	3.2	.16	60.7
	1995	44	2.3	.12	52.3
	1996	34	1.8	.10	50.0
	1997	73	3.8	.22	68.5
	1998	36	1.9	.10	52.8
	1999	39	2.0	.12	43.6
Hardwick	1993	150	16.9	.30	66.7
	1994	65	7.3	.18	73.8
	1995	37	4.2	.21	51.4
	1996	26	2.9	.16	46.2
	1997	57	6.4	.34	57.9
	1998	25	2.8	.14	64.0
	1999	23	2.6	.13	43.5
New Salem	1993	98	13.4	.24	59.2
	1994	41	5.6	.14	46.3
	1995	27	3.7	.18	66.7
	1996	7	1.0	.05	42.9
	1997	9	1.2	.06	44.4
	1998	N/A[b]	-	-	-
	1999	9	1.2	.06	33.3
Petersham	1994	456	33.9	.54	60.5
	1995	148	11.0	.26	75.7
	1996	47	3.5	.17	70.2
	1997	106	7.9	.38	64.2
	1998	40	3.0	.14	52.5
	1999	21	1.6	.09	23.8
Overall	-	3387	-	Mean = .20	Mean = 55.1

Source: (MDC/DWM-Natural Resources, 2000)

[a] Represents the number of deer killed per square mile. [b] New Salem block was not hunted during 1998.

4.2.2 Assessment

The majority of MDC/DWM lands in the Quabbin Reservoir watershed and Ware River watershed are 60 year old forests. The DWM's ownership policies for existing forested and non-forested lands as well as new acquisitions are periodically reviewed and updated as necessary. *The MDC/DWM Quabbin Watershed Land Management Plan* describes DWM staff activities on DWM lands in greater detail. The *MDC/DWM Ware River Watershed Land Management Plan* is under development at the time of publication.

Ownership Policies: DWM policies regarding its ownership all have been re-evaluated in recent years, modified as necessary, and incorporated into the *Land Management Plan.*

Management of New Acquisitions: DWM has in place a system to evaluate and address newly acquired parcels. Through the planned Land Management Plan, DWM will formalize relevant policies and criteria for decisions, such as whether to reforest a field, whether to keep or demolish a structure, and how to respond to access issues consistent with the *Public Access Plan.* These new acquisitions are an important addition to the long-term preservation of the Quabbin Reservoir and Ware River watersheds, and their proper management is key to obtaining the most benefit to the public drinking water supply.

Management of MDC/DWM Non-Forested Lands: DWM has recently begun different approaches to managing its non-forested lands. The MDC/DWM Land Management Plans will coordinate and specify the management of non-forested lands consistent with wildlife habitat manipulation, public access, and other watershed protection programs.

Management of MDC/DWM Forests (Silviculture): DWM continuously re-evaluates its forest management practices, with the primary objective of improving this program's ability to provide the best possible protection for the watershed, while addressing associated goals for diversity and management efficiency. On MDC/DWM's lands in the Quabbin Reservoir and Ware River watersheds in recent years, this has included adjustments to silvicultural opening sizes to improve regeneration success, adaptations to recent forest health concerns, including the arrival of the hemlock woolly adelgid, and a commitment to maintaining sufficient coarse woody debris to support ecosystem functions. The annual internal review of proposed timber harvesting is detailed above. The Division has also committed to an annual public review of each Fiscal Year's accomplishments toward completing the tasks of its 10 year Land Management Plans. Proposed changes to forest management plans are also reviewed by the Quabbin and Ware River Watershed Advisory Committees. The Division also hosts an annual meeting of the Quabbin Science and Technical Advisory Committee (QSTAC). QSTAC is composed of 40 scientists and managers who address specific watershed forest management issues during its 1-2 day annual meeting.

White-tailed Deer Impact Management Program: After several years of controlled hunts, substantial reductions in deer population densities were achieved in all hunt areas, and MDC/DWM has been in the maintenance phase of its program for several years. The maintenance phase of the program is essential for maintaining stable deer population levels and eliminating potentially large swings in deer densities that could occur if hunting were stopped for an extended period of time. In the absence of regular hunting mortality, deer populations at lower densities that have little natural mortality and an increasing food supply, would expand and could jeopardize the regeneration progress made to date.

4.2.3 Control Approach

4.2.3.1 Goals

DWM's goal is to maximize the long-term water quality benefit from MDC/DWM-owned lands by restoring and maintaining stable forest cover and other appropriate vegetative cover in selected areas.

4.2.3.2 Five-Year Objectives

DWM identified the following specific objectives for the coming five-year period.

1. Assess and implement immediate management needs on all newly acquired lands. Keep forest assessment updated following new acquisitions.
2. Prepare a ten-year comprehensive land management plan for the Ware River watershed.
3. Continue to implement the current *Quabbin Land Management Plan*, which expires in 2004. Begin drafting the 2005-2014 Quabbin Land Management Plan in 2001.
4. Continue to implement the current Quabbin Reservation 5-Year (2000-2004) White-tailed Deer Impact Management Program.
5. Establish regeneration and new forest layers through a conservative, non-intensive silvicultural approach as well as with limited enrichment plantings in specific locations based on forest monitoring.
6. Continue to monitor and control deer browsing impacts on the establishment and survival of forest regeneration.

Long-Term (60 years)

1. Establish a diverse, stable, multi-layered forest within the next 60 years.
2. Develop a method to evaluate the relative importance of the sub-basins within the drainage basin of the Quabbin Reservoir to determine watershed protection priorities.
3. Continue a research program aimed at assisting watershed management.
4. Continue to work with the Quabbin Science and Technical Advisory Committee (QSTAC) to annually revise the plan to meet these long-term objectives, and to modify and implement the MDC/DWM's watershed management research program.

4.2.3.3 Activities

1. Develop and implement the *MDC/DWM Ware River Watershed Land Management Plan* including:
    - Review current management approach on all forested and non-forest areas. Identify opportunities to modify approach to benefit other goals including wildlife habitat manipulation, effective access control, and stormwater management.
    - Define management goals for Ware River watershed forests and non-forests (e.g., fields, shorelines)
    - Prepare plans for activities during the ten-year period, including: fire/access roads, bridges, restoration of newly acquired land, forestry, monitoring of conservation easements and leases, and detailed inventories.
    - Assess water quality impacts/benefits of planned activities.
    - Prepare draft of *MDC/DWM Ware River Watershed Land Management Plan.*
    - Prepare final *MDC/DWM Ware River Watershed Land Management Plan.*

2. Complete assessment of all newly purchased lands, with maps and forest assessment based on field sampling.

3. Continue to conduct selected silvicultural activities to attain water quality protection goal. Conduct inspections to ensure compliance with DWM forestry BMP requirements.

4. Continue maintenance and annual assessment phases of the Quabbin Reservation White-tailed Deer Impact Management Program.

4.3 Public Access Management

Accomplishments:

Completion of public access management plan updates for the Quabbin Reservoir and Ware River watersheds, including:

- Increasing protection of watershed lands, the reservoir, and all intakes.
- Reducing, eliminating, or requiring permits for certain access/activities.
- Completing Pilot Sanitation Study – Quabbin Reservation.
- Installing portable bathrooms at high use areas (e.g., Enfield look-out).
- Initiating education programs to provide the public with information concerning MDC/DWM rules and regulations.
- Establishing Watershed Ranger program in both watersheds.

Assessment:

- MDC created a comprehensive and effective program of control over recreational activities by establishing the following: "no access" protective zones around water supply intakes, the presence of an active watershed ranger force, and specific control measures for permitted activities with limitations. The updated public access policies are specifically aimed at preventing the introduction of microbiological pathogens.
- MDC/DWM has established and maintains a sanitation program throughout its lands in both watersheds, to accommodate increasing numbers of recreational users in remote locations.

Key Activities:

- Continue Watershed Ranger program to patrol, educate, and intervene.
- Coordinate with State Police when needed to enforce the public access regulations.
- Implement easy-to-read signs throughout watersheds.
- Develop brochures to aid public knowledge of rules.
- Revise the current access limitations as needed.
- Continue to monitor and evaluate sanitation program on DWM lands.

4.3.1 Program to Date

4.3.1.1 History

MDC/DWM-owned lands comprise 57% of the Quabbin Reservoir watershed (excluding the Quabbin reservoir's surface area), and 37% of the Ware River watershed (see **Section 4.1**). The MDC/DWM acquired these lands to protect the long-term quality of the Wachusett and Quabbin Reservoirs. However, a number of special legislative acts specifically directed the agency to allow access to the shoreline of the reservoirs and tributary streams for fishing. Fishing from boats at the Quabbin Reservoir was similarly mandated in the 1950's. As a direct result of these mandates, the MDC also permitted limited use of these lands for passive recreation and educational research activities.

MDC/DWM controls these activities through its regulations (350 CMR 11.00). The MDC consistently maintained strict regulations on MDC property, and activities conducted thereon that could impact water quality. Since shortly after the turn of the century, the Quabbin Reservoir, its watershed lands, and the Ware River watershed lands, owned by the MDC/DWM, were protected through regulations in 310 CMR 23.00, 350 CMR 8.00, 350 CMR 9.00, and 350 CMR 10.00. In accordance with an Executive Order to streamline Commonwealth regulations, these were incorporated into 350 CMR 11.00 with the changes made to accommodate the passage of the WsPA (Chapter 36, Acts of 1992). The MDC watershed protection regulations were promulgated in accordance with M.G.L. Chapter 92, and contain a significant penalty for violations. The regulations provide general conditions for water supply protection, and give the MDC/DWM sole jurisdiction of its lands and the authority to close parts of the watershed system to public access, when deemed necessary, to protect land and water resources from degradation.

Prior to adoption of the 1991 Watershed Protection Plans (WPPs), the Metropolitan Police were primarily responsible for enforcing public access regulations governing activities on MDC land. The Metropolitan Police (now the Massachusetts State Police) worked with watershed staff to apprehend violators, followed by criminal enforcement per statute. Alternative disposition approaches, such as non-criminal penalties or warnings and public education, were used sparingly on sporadic encounters between watershed staff, state police, and visitors. Generally, enforcement was handled as a police matter.

With the development and implementation of WPPs for the Quabbin Reservoir and Ware River watersheds (MDC, MWRA, and Rizzo Associates, 1991a), numerous concerns were raised with respect to the water quality impact of recreational activities on land, particularly within areas at or near the shoreline of the reservoir, the Ware River Intake, and surface waters. Recreational activities were identified as a high threat to the water quality of the Quabbin Reservoir, and a moderate threat to the water quality of the Ware River. The 1991 Plans suggested evaluating the effectiveness of the existing public access regulations, as well as increasing enforcement.

After several years of data collection, analysis, and public input, concerns about the water quality impact of recreation in the watersheds of the Quabbin Reservoir and Ware River were addressed through the development of updated, comprehensive public access plans for each watershed (MDC, 1988; MDC, 1998; MDC, 2000). As part of the development of the plans, an inventory of public access-related threats was conducted, and policy changes and maintenance activities were prioritized to mitigate these threats. The new public access management plans contain analyses of use impacts, scientific literature, and policies at other water utilities. MDC's exclusive jurisdiction and regulatory authority assure a high degree of control over activities that threaten the water supply.

4.3.1.2 Current Program and Accomplishments

The completion of the updated public access management plans for the Quabbin Reservoir and Ware River watersheds significantly strengthened DWM policy to protect its water supply. The plans were concerned with both controlling the occurrence of unauthorized or restricted activities and with improving supervision and regulation of authorized activities near sensitive and at heavier use sites. These plans called for, and led to, many improvements in the management of public access to MDC land, including:

- Increasing the level of protection at reservoir and intakes.
- Reducing the number of activities allowed along reservoir shoreline areas.
- Eliminating activities that could not be adequately controlled.
- Initiating a Watershed Ranger program to oversee public access and recreational activities and improve rules compliance.
- Implementing a permit program for specific activities.
- Installing sanitary facilities, where needed.
- Inventorying and assessing sites, and installing BMPs to protect water resources.
- Developing better signs to clarify rules and regulations and to guide use.
- Installing appropriate access barriers to DWM lands; working with abutters.
- Improving education programs and establishing an educational resource center.

- Providing more outreach programs to watershed communities.

Access to MDC/DWM lands in the Quabbin Reservoir watershed is allowed from one hour before dawn to one hour after dusk, except in the Intake Protection Zones of the Quabbin reservoir, where no public access is allowed except for tour groups or individuals with a permit. **Table 4-11** summarizes the authorized recreational activities in MDC/DWM waters and lands according to current public access plans and policies in the three active watersheds (see Appendix for more detailed Public Access Policy Summaries for the Quabbin Reservoir and Ware River watersheds). At this time, specific public access activities (e.g., walking) on MDC/DWM lands in the Ware River watershed are allowed without the night restriction. However, several activities do require special access permits, irregardless of the time of day. **Figures 4-1A & B** show the access restriction areas and other public access management zones in the Quabbin Reservoir and Ware River watersheds, respectively.

With the implementation of the public access plans and policies, DWM also implemented a more comprehensive patrol and enforcement approach. In the Quabbin Reservoir watershed, there are presently five watershed rangers stationed within Quabbin Park, where they can patrol the CVA, dam, spillway, and dikes readily and can react rapidly to any problems in the immediate area of the intakes. The Watershed Rangers provide daily coverage in both watersheds including holidays and weekends, spending approximately 70% of their time patrolling MDC/DWM lands and waters. **Figures 4-2A & B** map the watershed ranger patrol zones in both the Quabbin Reservoir and Ware River watersheds. The Watershed Rangers give special attention to the restricted areas: primary protection zones, the area within 400' of the reservoir and 200' of tributaries and surface waters, and the reservoir. Boat patrols are also noted.

The watershed ranger staff work closely with various police agencies to ensure enforcement of DWM rules, the existing regulations, and the investigation of criminal matters. Types of incidents addressed by the watershed rangers consist of trespassing, domestic animals, boating, and bicycling, as well as illegal swimming/wading, and illegal dumping on watershed property. To date, rule enforcements have been a small percentage of the total visitor contacts made by the watershed rangers.

The watershed rangers are not dedicated solely to rules enforcement, they also educate the public about the reasons for MDC/DWM's access limitations. (This educational aspect of the watershed rangers' work is described in further detail in **Section 5.4**). There have already been many positive signs about the effects of the Watershed Ranger program, such as diminished human and domestic animal contacts with the waters of the watershed. The Watershed Ranger program has resulted in an increased MDC field presence to visitors, increased monitoring, a consistent approach to rule enforcement activities, and a compliance-focused educational component. A cooperative working relationship is established and maintained with the State Police, who have dedicated specific duty assignments to the watershed system.

Table 4-11

Currently MDC/DWM Authorized Public Access Activities on DWM Lands in Quabbin Reservoir Watershed and Ware River Watershed

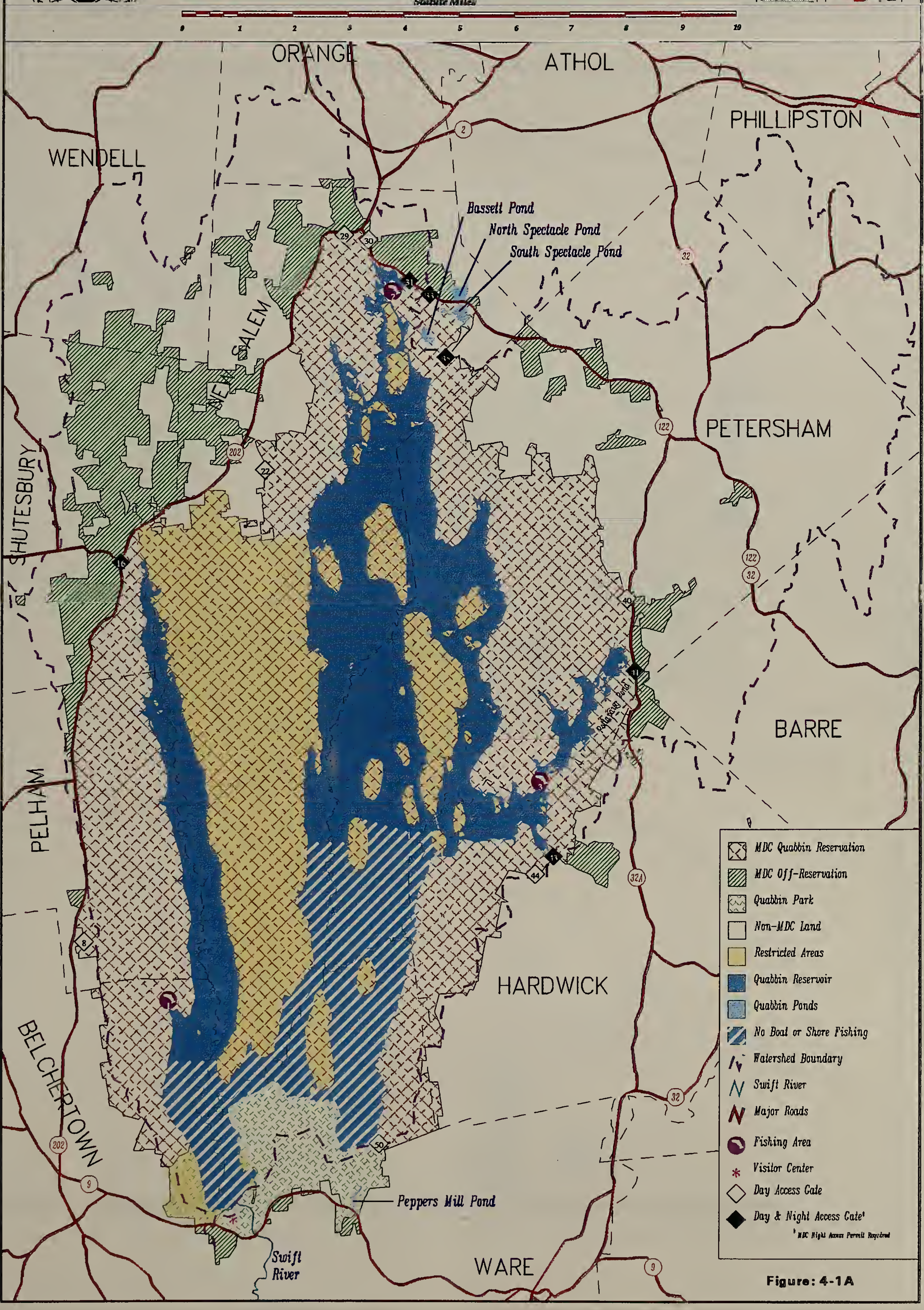
Activity	*Quabbin Reservoir Watershed*	*Ware River Watershed*
Swimming	Prohibited	Designated Area with specific restrictions
Boat Launching	Designated Area/Designated Time with specific restrictions	Not Applicable
	Designated Area/Designated Time with specific restrictions	Designated Area/Designated Time with specific restrictions
Non-Motorized Boats	Designated Area/Designated Time with specific restrictions	Allowed
Shore Fishing	Designated Area/Designated Time with specific restrictions	Not Applicable
Stream Fishing	Designated Area/Designated Time with specific restrictions	Allowed
Pond Ice Access	Designated Area	Designated Area
Walking/Hiking	Designated Area	Designated Area
Bicycling	Designated Area	Designated Area
Cross-Country Skiing	Designated Area	Allowed
Dog Walking	Prohibited	Allowed with guidelines
Horseback Riding	Prohibited	Designated Area/Designated Time with specific restrictions
Snowmobiling	Prohibited	Designated Area/Designated Time with specific restrictions
Hunting	Designated Area/Designated Time with specific restrictions	Allowed
Camping	Prohibited	Prohibited with one exception
Night Access	Allowed with permit only	Allowed

Source: (MDC/DWM, 1998 & 2000)

MDC Division of Watershed Management

Public Access Areas

Quabbin Reservoir Watershed System


Statute Miles
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ORANGE
ATHOL
PHILLIPSTON
WENDELL
NEW SALEM
SHUTESBURY
PETERSHAM
BARRE
PELHAM
HARDWICK
BELCHERTOWN
WARE
Bassett Pond
North Spectacle Pond
South Spectacle Pond
Pottapaug Pond
Peppers Mill Pond
Swift River
2
32
122
202
32A
9
29
30
22
16
40
44
8
50
MDC Quabbin Reservation
MDC Off-Reservation
Quabbin Park
Non-MDC Land
Restricted Areas
Quabbin Reservoir
Quabbin Ponds
No Boat or Shore Fishing
Watershed Boundary
Swift River
Major Roads
Fishing Area
Visitor Center
Day Access Gate
Day & Night Access Gate¹
¹ MDC Night Access Permit Required
NORTH

Figure: 4-1A

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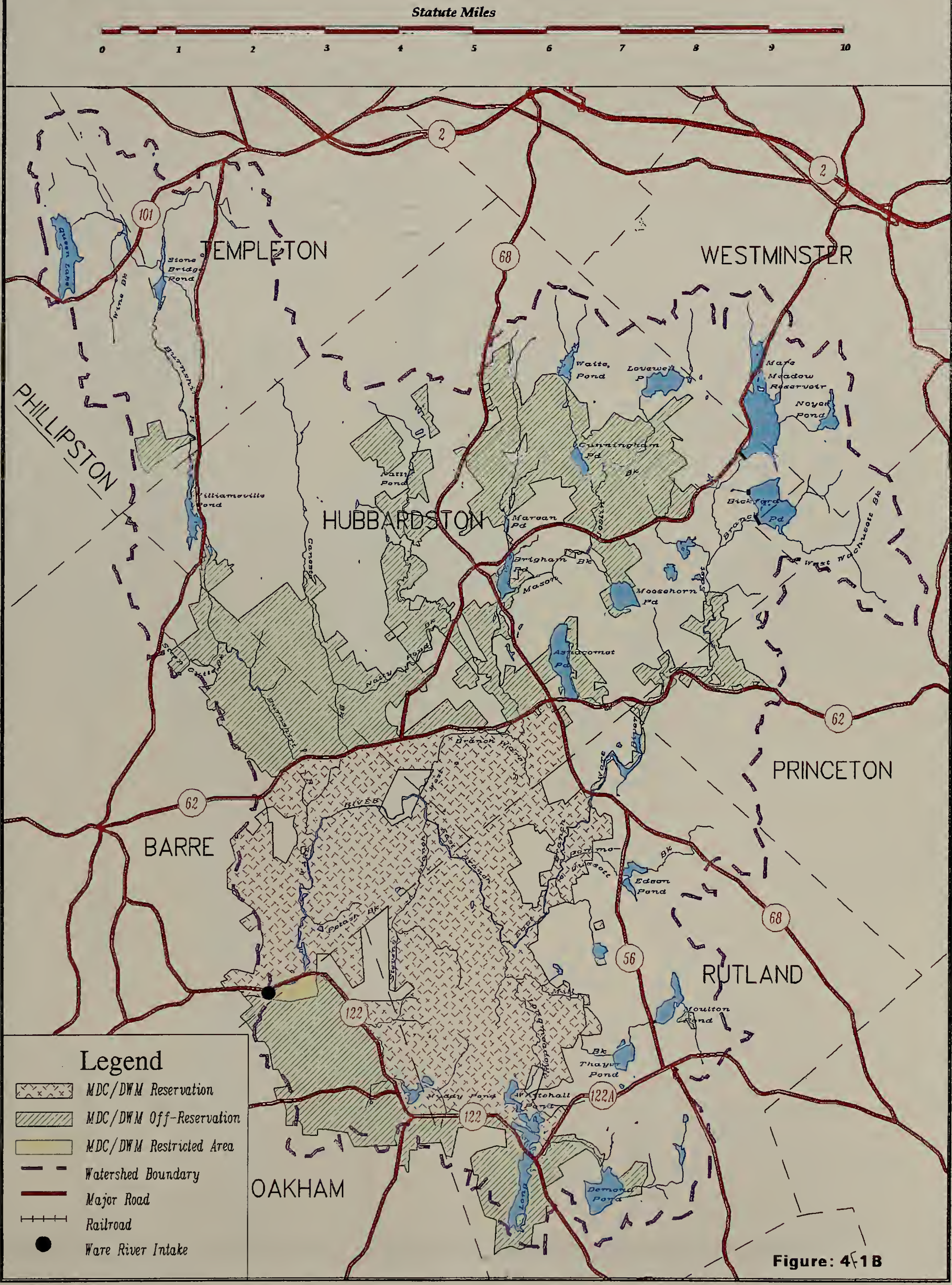
MDC Division of Watershed Management

Public Access Areas

Ware River Watershed System


Statute Miles
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TEMPLETON
WESTMINSTER
PHILLIPSTON
HUBBARDSTON
PRINCETON
BARRE
RUTLAND
OAKHAM
2
101
68
62
56
122
122A
Queen Lake
Wine Bk
Stone Bridge Pond
Burnshirt R
Williamsville Pond
Canesto Bk
Natty Pond
Natty Pond Bk
Watts Pond
Lovewell P
Wachusett Meadow Reservoir
Noyes Pond
Cunningham Pd
Bickford Pd
West Wachusett Bk
Morgan Pd
Brigham Pd
Mason
Moosehorn Pd
Asnacomet Pd
Ware R
Edson Pond
Moulton Pond
Thayer Pond
Whitehall Pond
Muddy Pond
Long Pond
Demond Pond
Potash Bk
East Branch
West Branch
Legend
MDC/DWM Reservation
MDC/DWM Off-Reservation
MDC/DWM Restricted Area
Watershed Boundary
Major Road
Railroad
Ware River Intake

Figure: 4-1B

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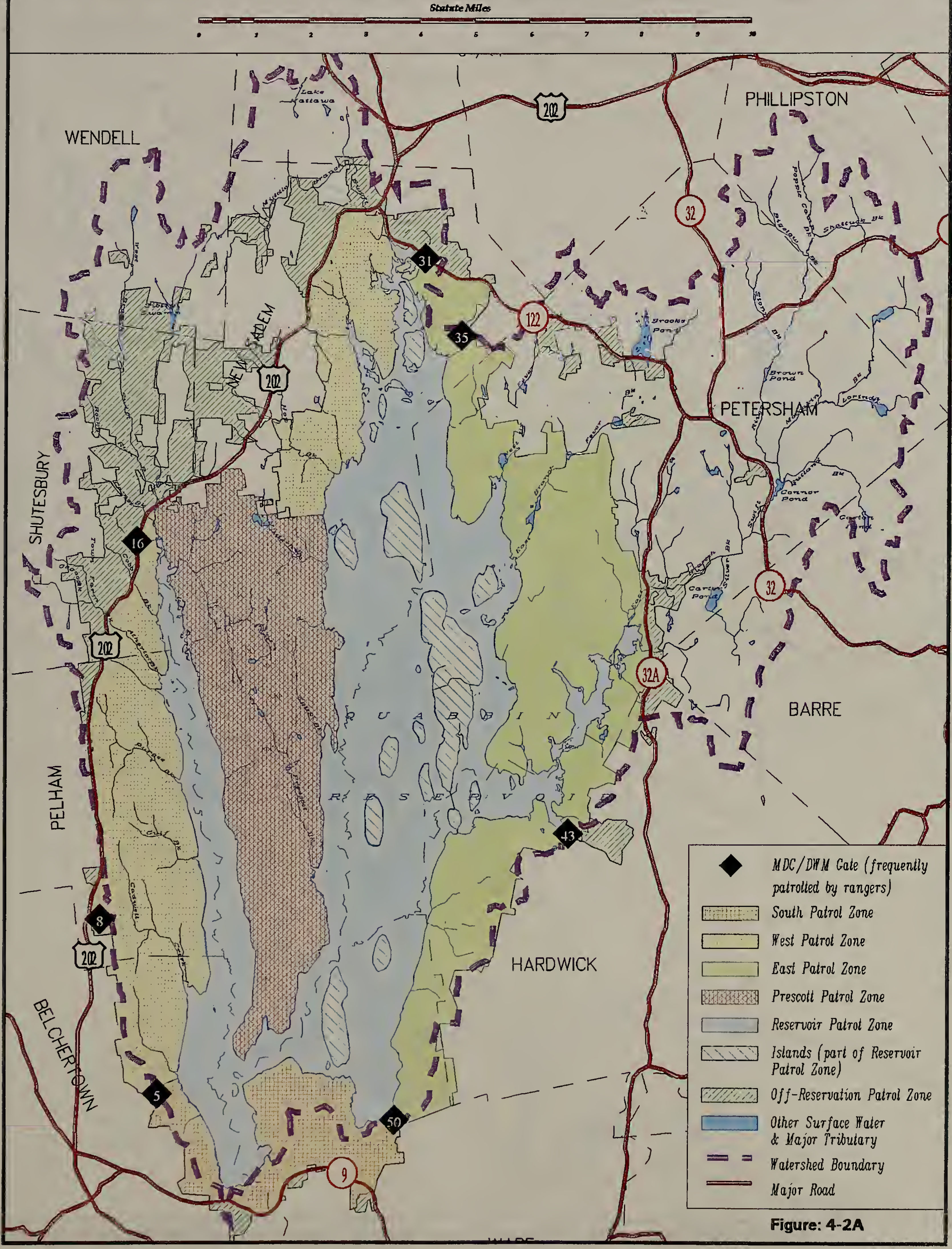
MDC/DWM
Quabbin Reservoir Watershed
Ranger Patrol Zones –1999


Statute Miles
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NORTH
WENDELL
PHILLIPSTON
SHUTESBURY
NEW SALEM
PETERSHAM
BARRE
PELHAM
HARDWICK
BELCHERTOWN
WARE
Q U A B B I N
R E S E R V O I R
Lake Wyola
Brooks Pond
Brown Pond
Connor Pond
Carter Pond
202
32
122
32A
9
31
35
16
8
5
50
43
◆ MDC/DWM Gate (frequently patrolled by rangers)
South Patrol Zone
West Patrol Zone
East Patrol Zone
Prescott Patrol Zone
Reservoir Patrol Zone
Islands (part of Reservoir Patrol Zone)
Off-Reservation Patrol Zone
Other Surface Water & Major Tributary
Watershed Boundary
Major Road

Figure: 4-2A

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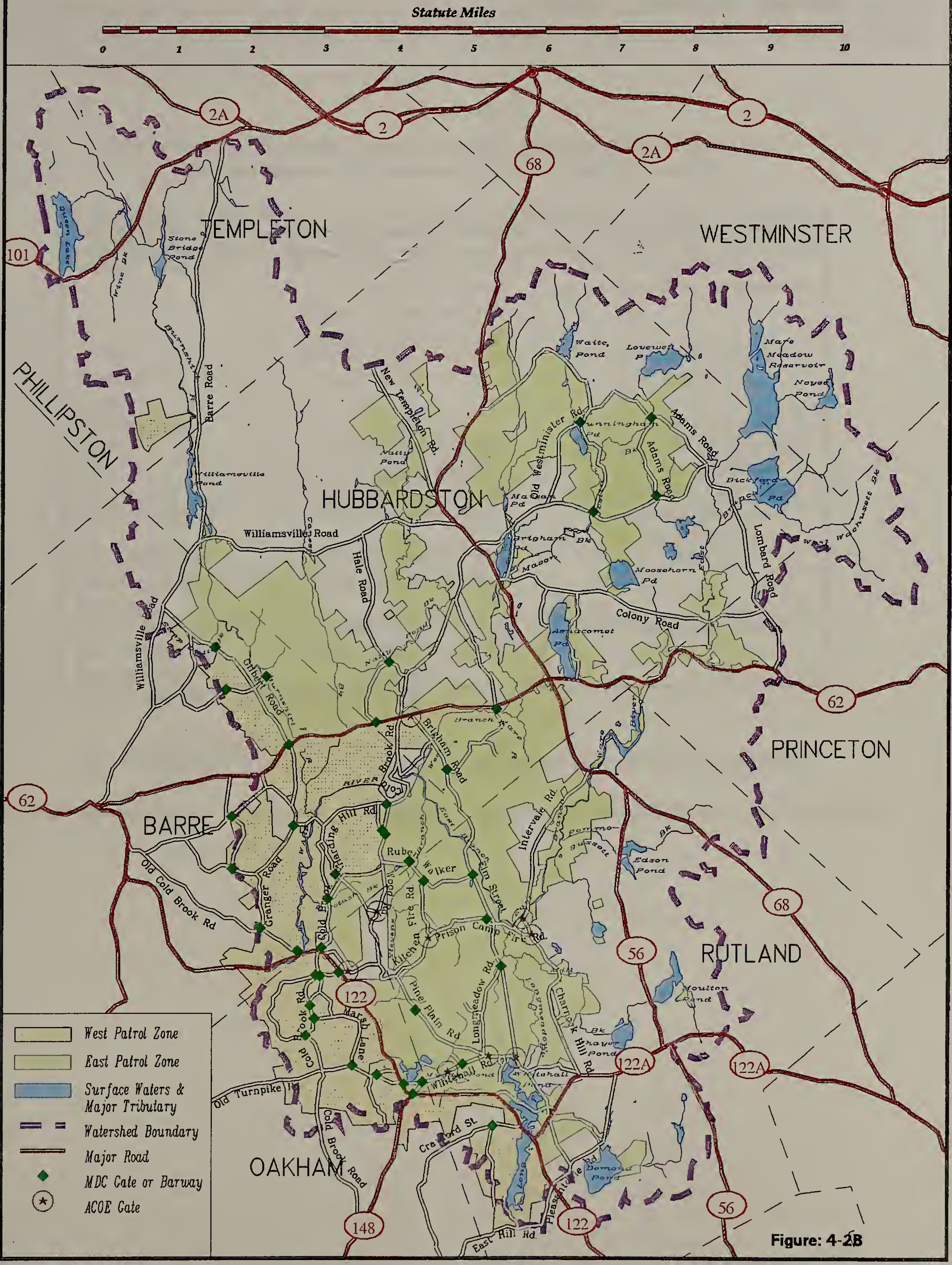
MDC/DWM
Ware River Watershed
Ranger Patrol Zone –1999


Statute Miles
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TEMPLETON
WESTMINSTER
PHILLIPSTON
HUBBARDSTON
PRINCETON
BARRE
RUTLAND
OAKHAM
62
56
122
122A
148
Stone Bridge Pond
Queen Lake
Wine Bk
Burnshirt R
Barre Road
Williamsville Pond
Williamsville Road
Williamsville Road
New Templeton Rd.
Natty Pond
Hale Road
Waite Pond
Lovewell P
Mare Meadow Reservoir
Noyes Pond
Old Westminster Rd
Cunningham Pd
Adams Road
Adams Road
Bickford Pd
Mason Pd
Brigham Pd
Mason
Moosehorn Pd
East Br
Lombard Road
West Wachusett Bk
Asnacomet Pd
Colony Road
Gilbert Road
Burnshirt
Brook Rd
Brigham Road
Branch Ware R
RIVER
Harding Hill Rd
Rube
Walker
Intervale Rd
Edson Pond
Old Cold Brook Rd
Granger Road
Cold Brook
Kitchen Fire Rd
Prison Camp Fire Rd.
Elm Street
Pine Plain Rd
Longmeadow Rd
Charnock Hill Rd
Moulton Pond
Thayer Pond
Whitehall Rd
Whitehall Pond
Marsh Lane
Cold Brook Rd
Old Turnpike Rd
Cold Brook Road
Crawford St.
Long Pond
Demond Pond
Pleasantville Rd
East Hill Rd.
West Patrol Zone
East Patrol Zone
Surface Waters & Major Tributary
Watershed Boundary
Major Road
MDC Gate or Barway
ACOE Gate

Figure: 4-2B

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Table 4-12 elaborates further on some of the key changes that have been made to MDC/DWM public access policies since 1988, when the first public access plan was formulated for the Quabbin Reservoir and Ware River watersheds (MDC, 1988).

Table 4 - 12

Changes to MDC/DWM Public Access Management Policies Since 1988
Quabbin Reservoir Watershed and Ware River Watershed

Activity or Program	*Quabbin Reservoir Watershed*	*Ware River Watershed*
Watershed Rangers	Program established; Staffing now 6 for both watershed areas; Quabbin Reservoir watershed patrol initiated.	Program established; Ware River watershed patrol initiated
Intake Protection/Restriction Zones	Shoreline no trespassing zone increased from 1 to 2 miles	Ware River Intake Protection Zone established
Snowmobiles	NC	Authorized trails redesignated
Horses	NC (remain prohibited)	Authorized trails redesignated
Fires	NC (remain prohibited)	NC (remain prohibited)
Bicycles	Allowed on designated roads	Authorized trails redesignated
Sanitary Facilities	Installed at 5 locations	Portable toilets installed at Comet Pond
White-Tailed Deer Impact Management Program	Program established, evaluated, and modified.	NA
Stream and Shoreline Best Management Practices (BMPs)	Installed along 8 miles of fishing access roads and other locations	Installed in several locations

Source: (MDC/DWM Watershed Rangers, 2000)

NA – Not applicable; NC - No changes made since 1988
See the MDC/DWM Public Access Management Plan Updates for more detailed information.

Table 4-13 demonstrates the types of rule enforcements made by the Watershed Rangers in 1998 and 1999.

Table 4-13

MDC/DWM Watershed Ranger Program Contacts
Quabbin Section
1998-1999

Watershed Ranger Contact Type	*1998*	*1999*
Type of Intervention:		
➢ Illegal Domestic Animals	110	147
➢ Trespassing	62	105
➢ Illegal Swimming or Wading	53	30
➢ Boating	24	16
➢ Biking, Sledding, Skiing, etc.	26	36
➢ Fishing	18	22
➢ Possession of Alcohol	14	7
➢ Fires or Cooking	16	10
➢ Dumping	NA	8
➢ Vandalism	NA	7
➢ MDC/DWM Permit Violations	NA	6
Total Rule Intervention	**323**	**394**
Total Visitor Contacts	**8,408**	**20,275**

Source: (MDC/DWM Watershed Rangers, 2000)

4.3.2 Assessment

The introduction of microbiological pathogens such as bacteria, viruses, and parasites is the greatest water quality concern from recreational use in the MDC/DWM controlled watershed lands and waters. The main pathogen source related to recreational use is fecal matter from improper human sanitation and deposits by dogs and horses. Additional sources of fecal matter may include litter items such as disposable diapers. Besides pathogens, other potential impacts from recreation include soil erosion, forest fires, and fuel spills from motorized vehicles.

The relative seriousness of pathogenic and other water quality threats vary according to many factors including: the activity type, the proximity of the activity to water resources and reservoir intakes, the magnitude and intensity of the activity, and the hydrodynamics of the reservoirs. DWM's implementation of a restrictive public access policy has served as the first line of defense to prevent source water being contaminated by recreational use. The Quabbin Reservoir and Ware River Intake are protected through the maintenance of a no-access area near all intake structures (e.g., Quabbin Aqueduct, CVA, and Ware River intakes) and by restricting recreational activities in other areas. MDC's access restrictions are most stringent near intakes and along reservoir shoreline areas and become less stringent in areas more hydrologically distant from the intakes.

Overall, visitors respect the access rules and restrictions on recreational activities. The Watershed Rangers maintain daily logs and corresponding database of all observed violations and verbal warnings/interventions. These logs show the most common violations are domestic animal incidents, trespassing, and bodily contact with the drinking water sources (see **Table 4-13**)

DWM has established a comprehensive and effective program of control over recreational activities based on the degree of control afforded by the MDC's regulatory authority, the establishment of extensive no-access protective zones around water supply intakes, the presence of an active Watershed Ranger force, and the control of permitted activities in direct relation to their potential water quality impact.

MDC now owns 54,203 acres in the Quabbin Reservoir watershed and 22,838 acres in the Ware River watershed. The vast majority of this is interior forest with little activity. While there are areas of recreational activity in certain visible locations such as the Quabbin Park and the three boat launch areas, these areas are staffed with MDC/DWM personnel and are monitored daily by the Watershed Ranger staff to evaluate, modify, and document activities to minimize potential impacts to water quality.

4.3.3 Control Approach

4.3.3.1 Goals

The goal of public access management is to minimize the threat to water quality from public use of MDC/DWM watershed lands. MDC strives to meet the goal by pursuing a three-tiered approach:

1. Gain community understanding and support for the MDC's public access policies. DWM attempts to encourage a sense of stewardship for the land and water under its jurisdiction, so that visitors adhere to reasonable regulations and report problem situations to DWM staff.

2. Attain compliance with and enforce the access regulations. With education concerning restrictions, patrols, and referrals to State Police, DWM aims to deter trespassing and illegal activities on MDC-owned lands and to ensure consistent enforcement against environmental crimes.

3. Assess protection afforded through the current access limitations and revise these as needed. Within a five-year period, DWM will evaluate the adequacy of current general and specific public access policies using inspections of conditions at recreation sites and water quality data.

4.3.3.2 Five-Year Objectives

DWM identified the following specific objectives for the coming five-year period.

1. Continue Watershed Ranger program.
2. Improve tools to inform public of access restrictions.
3. Re-evaluate recreation impacts as needed.

4.3.3.3 Activities

1. Continue full implementation and evaluation *of MDC/DWM Public Access Plan - Quabbin Reservoir Watershed System* and the *MDC/DWM Public Access Management Plan Update - Ware River Watershed.*

2. Continue with the Watershed Ranger program to improve voluntary compliance with the public access regulations through public education. Ensure interdepartmental cooperation concerning access, recreational impacts, etc.

   a. Continue dawn to dusk patrols to provide patrol coverage of the watersheds.

   b. Continue using daily logbooks to record all encounters and violations.

  c. Create a database and consider designating an administrative support person to aid in providing data to rangers on a call-in basis.

  d. Develop materials (brochures, fishing map, flyers, stickers) to aid in informing visitors of access rules (as well as general watershed information).

3. Continue to ensure enforcement of public access regulations through partnership with the State Police, EPOs, and other local police departments.

4. Develop and install updated signs throughout the watersheds. Prepare a signage plan including signs announcing entry into the watershed, access/activity signs, and interpretive signs. Design signs to be easily understood, including colors and/or graphics.

5. Reduce the number of dogs observed within the gated areas of Quabbin Reservation to less than 10/year.

6. Complete implementation of the bicycle policy.

   a. Enforce the existing rule that bicycling is not allowed on most watershed lands except in designated areas.

   b. Install new signs with the universal symbol for no bikes.

7. Analyze water quality or erosion impacts of certain activities or sites as needed and through sanitary inspections.

8. Continue to deter unauthorized activities according to existing regulations and based on the policies of the public access management plans.

4.4 Additional Protected Lands

Accomplishments:

- DWM has identified, characterized, and positively affected the protected lands owned by other parties in the watersheds, including becoming familiar with the type of forest management and public access allowed on these lands.
- DWM staff supported the development of the North Quabbin Regional Landscape Partnership (NQRLP) to collaboratively protect lands in parts of the Quabbin Reservoir and Ware River watersheds with projects shared by federal and state agencies, municipalities, non-profits, and concerned citizens.

Assessment:

- In addition to the 77,041 acres owned or controlled through agreement by MDC/DWM in the Quabbin Reservoir and Ware River watersheds, 29,893 are in protective ownership by EOEA agencies, towns, private non-profits, and private landowners in the Chapter 61 program.

Key Activities:

- Maintain inventory of protected lands, assess management practices, and work with owners where needed.
- Pursue conservation restriction or other agreements.
- Provide public education/technical assistance to private landowners to develop land management plans and enter Chapter 61 programs.
- Where appropriate, coordinate with DEM to ensure compliance with the MA Forest Cutting Practices Act within the watersheds.
- Maintain involvement and support of the NQRLP to complement DWM's land protection efforts.

In addition to the MDC/DWM managed lands, 20% of the Ware River watershed and 18% of the Quabbin Reservoir watershed (excluding the reservoir) are preserved in protective ownership by various other parties. This section quantifies such lands and the watershed value they provide, identifies other owners, and discusses DWM's role in their long-term preservation and management. Altogether, these 29,893 acres of natural forests and fields contribute greatly to the excellent quality of the Quabbin Reservoir.

4.4.1 Program To Date

4.4.1.1 History

Many lands throughout the watersheds were purchased, protected, and maintained by parties other than the MDC/DWM. While most of these purchases were not made solely for drinking water supply purposes, the natural, vegetated condition of these lands and their management practices (e.g., restricted or no uses) provides water quality protection. Further, the state, county, and town governments are restricted under Article 97 from transferring or changing the use of their open space lands[3], ensuring that these holdings remain preserved in perpetuity.

The primary agencies and organizations that provide protective ownership in the Quabbin Reservoir and Ware River watersheds are:

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[3] Without a two-thirds vote of the Legislature based on exceptional circumstances.

Massachusetts Department of Environmental Management (DEM) - DEM owns lands in the Quabbin Reservoir and Ware River watersheds, all designated State Forest. These lands are governed by specific purposes set by statute, and cannot be developed. Active forestry (cutting and planting) can occur on these lands.

Massachusetts Department of Fisheries and Wildlife (MDFW) – MDFW owns several properties in the two watersheds. These lands have wildlife management and hunting among their purposes.

Local towns - The watershed communities own a number of conservation properties. Many of these town-owned watershed lands are designated water supply lands (e.g., Fitchburg Water Supply), conservation lands, or town forests.

Nonprofit conservation organizations - Organizations such as the Massachusetts Audubon and the Trustees of Reservations own numerous properties in the Quabbin Reservoir and Ware River watersheds. These lands were purchased by the various organizations specifically for preservation, scenic value, wildlife habitat, and/or presence of rare species (plant or animal).

Certain lands owned by private landowners may also be considered protected. This includes those lands, often termed “Chapter 61 lands” that are classified following the completion of documentation requirements and management plans. Land used for forestry (Chapter 61), for agriculture (Chapter 61A), and for private conservation and recreation (Chapter 61B) are eligible. The Chapter 61 programs provide incentive to protect private open space by establishing reduced property tax rates for qualified lands.

The Chapter 61 program protects against residential or commercial development; however, lands can be removed from the program if the owner reimburses the town for the tax reductions plus pays a penalty. Note that while lands can be removed from the Chapter 61 program (via payment of past tax benefits plus a penalty), the WsPA requires towns to notify DWM of any lands being removed from this status. This has allowed DWM to assess such properties and to acquire them where appropriate. In sum, Chapter 61 lands are significant as a control on urbanization, but may admit agricultural activities of potential concern.

Historically, DWM has had minimal involvement in other parties’ purchase and management of conservation lands. In the past several years, DWM began communicating with these entities on mutual protection interests. Similarly, DWM historically had modest involvement with Chapter 61 lands, but has been quite active since the mid 1980’s in increasing the total watershed acreage protected by Chapter 61 classification.

4.4.1.2 Current Program and Accomplishments

Since its inception in 1985, DWM has taken steps to identify, characterize, and positively affect the protected lands owned by other parties. For example, during the development of the WPP in 1991, DWM developed maps of other protected lands and, for the first time, identified the amounts of lands protected by various parties.

For this Plan Update, the additional protected lands have been re-evaluated using DWM’s GIS data. Preserved lands include those owned by MDFW, other governmental agencies, and most of the nonprofit conservation organizations. Based on the possibility of agricultural activity on certain land categories (namely, DFA Agricultural Preservation Restrictions (APR), and Chapter 61A) these lands have been separated into another category termed Protected Open Space. It is likely that many of these properties (particularly the APRs and Chapter 61A lands) are not actively used for agriculture, but remain classified due to past use. Regardless, the lands’ classification is important, as it removes them from potential urbanizing development and maintains them as vegetated lands in forest or field.

At present, 17,369 acres in the Quabbin Reservoir watershed and 12,524 acres in the Ware River watershed are protected by other parties. **Table 4-14** summarizes the areas protected by key landowners. **Figure 4-3** shows the protected open space, by category of owner, for the Quabbin Reservoir and Ware River watersheds.

Table 4 - 14

Additional Preserved and Protected Lands

Quabbin Reservoir and Ware River Watersheds 1999

Category	*Quabbin Reservoir Watershed (acres)*	*Percent of Quabbin Reservoir Watershed**	*Ware River Watershed (acres)*	*Percent of Ware River Watershed**
Preserved Lands:				
➢ EOEA Agencies	5,577	6%	3,490	6%
➢ Municipalities/Government	103	<1%	2,147	3%
➢ Nonprofit Conservation Organizations	3,991	4%	660	1%
➢ Chapter 61, 61B, Low Intensity 61A	4,608	5%	3,021	5%
Subtotal Preserved Lands	14,279	15%	9,318	15%
Protected Open Space (APRs, Chapter 61A)	3,090	3%	3,206	5%
Total Additional Preserved and Protected Lands	**17,369**	**18%**	**12,524**	**20%**

Source: (MDC DWM GIS Dept., 2000) Information generated using MassGIS open space datalayer. An analysis is underway using the new Ch. 61 inventory and the agriculture inventory to determine which of these are in active agriculture use and which are fallow; the fallow or low intensity properties will be moved into the Chapter 61, 61B, and low intensity 61A category.

* Percent of watershed based on total watershed area, excluding reservoir surfaces.

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MDC

Protected Open Space Ownership in the Quabbin Reservoir and Ware River Watersheds

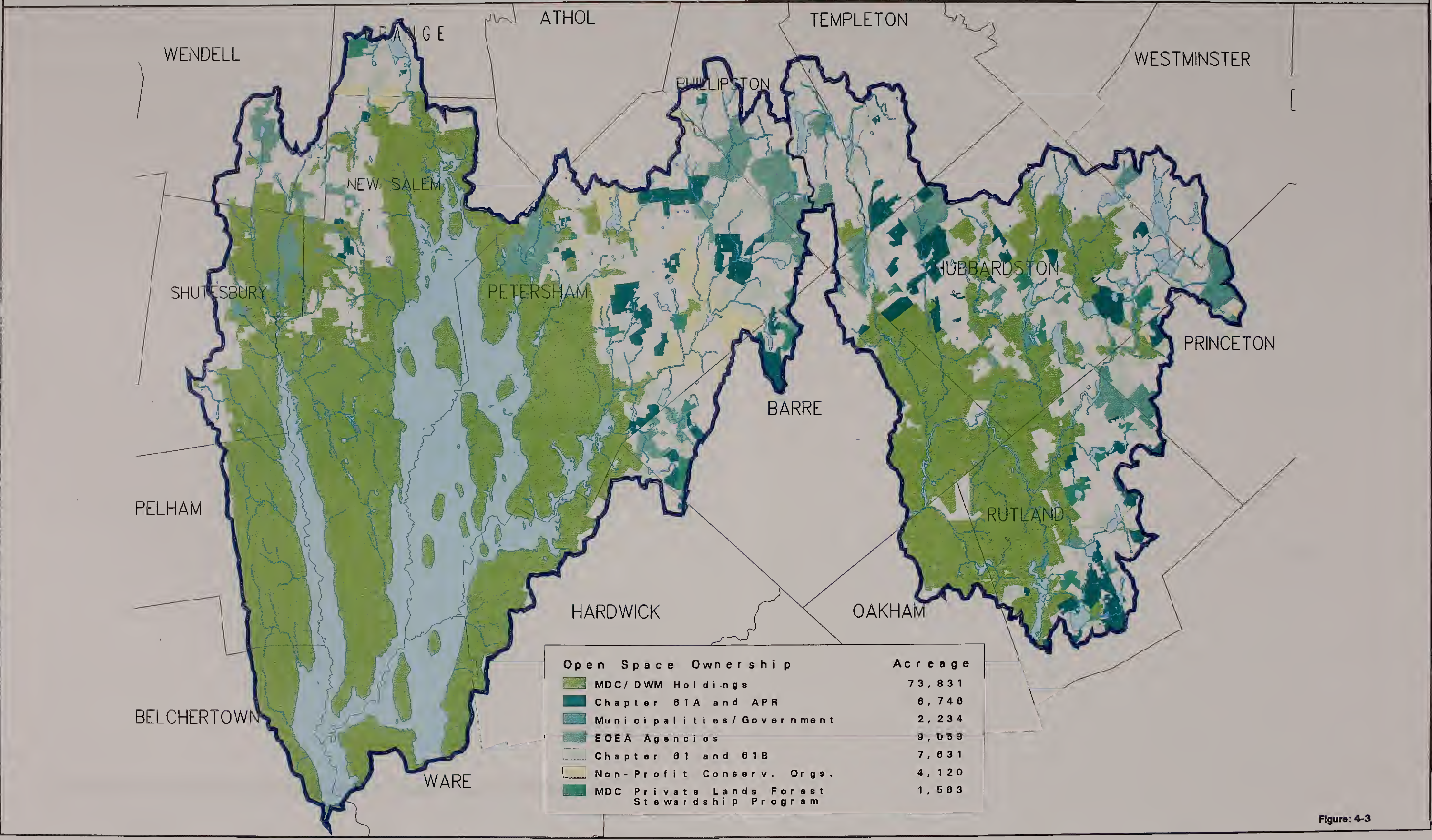
Showing Various Levels and Types of Protection

Statute Miles

0 1 2 3 4 5 6 7 8 9 10

EXECUTIVE OFFICE of ENVIRONMENTAL AFFAIRS

MASSGIS


WENDELL
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TEMPLETON
WESTMINSTER
PHILLIPSTON
NEW SALEM
SHUTESBURY
PETERSHAM
HUBBARDSTON
PRINCETON
BARRE
PELHAM
RUTLAND
HARDWICK
OAKHAM
BELCHERTOWN
WARE

Open Space Ownership	Acreage
MDC/DWM Holdings	73,831
Chapter 61A and APR	6,746
Municipalities/Government	2,234
EOEA Agencies	9,059
Chapter 61 and 61B	7,631
Non-Profit Conserv. Orgs.	4,120
MDC Private Lands Forest Stewardship Program	1,563

Figure: 4-3

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Agencies, Municipalities, and Non-Profits

To address the management of the permanently protected lands owned by agencies and organizations, DWM has become familiar with the type of forest management and public access allowed on these lands. Currently, the different owners may have different purposes for their properties (such as recreation or wildlife management) other than watershed protection, although this is an ancillary benefit. DEM conducts occasional forest activities for habitat or timber management also to diversify the forest cover for water supply protection. Recreational activities are non-intensive. With involvement from DWM staff, DEM recently completed revisions to its forestry BMPs. These improvements make Massachusetts forestry BMPs among the strictest in the U.S. For the most part, the management of these lands has been highly compatible with water quality protection.

The towns' management of their conservation lands and forests probably varies in management style from no management to controlled recreation access (e.g., walking trails), to perhaps some with park facilities. For example, in the Ware River watershed, the City of Fitchburgs's water supply lands were purchased to protect Fitchburg's water supply, and are highly protected forests with no public access.

Conservation organizations, the largest landholders of which are Massachusetts Audubon Society, and Trustees of Reservations, are the most likely to practice no active management, since their objectives often focus on wildlife and preservation of lands in their wild, natural state. Although, specific public access restrictions (e.g., motorized vehicles) are increasingly more common.

To date, DWM has focused on enhancing its own land holdings and management practices and, until recently, has had a minor role in overseeing management of privately held protected open space.

MDC/DWM Private Lands Stewardship Program
Private Landowners Under Chapter 61

DWM has become more involved over the past few years with private landowners, especially through the Forest Stewardship and Chapter 61 programs. By assisting private landowners to protect their land as open space under Chapter 61, DWM can reduce development pressure on sensitive lands. Forest Stewardship and Chapter 61 registration also help to identify private forestry operations and agricultural activities and to provide DWM an opportunity to ensure that private land management activities are conducted in a manner that is compatible with water supply protection.

DWM recently completed an updated compilation and mapping of Chapter 61 classified properties. (Previously, the MassGIS Open Space Data Layer, developed on a statewide basis, was the only readily available source for this information.) DWM's effort was conducted with an intern from the Pure Water Stewardship Committee and DWM staff. During fall 1997, data from each watershed town's Assessors Office was collected. For all parcels consisting of 5 acres or more, the tax classification was examined. All Chapter 61, 61A, and 61B classified parcels were identified and additional data collected. To create maps, the database was then linked with DWM's GIS coverage of parcel boundaries. This database is the only recent comprehensive mapping of its kind, and has already been useful to DWM and other agencies.

Based on this analysis, present Chapter 61 lands in the Quabbin Reservoir and Ware River watersheds are summarized below in **Table 4-15.**

Table 4-15

MA Chapter 61 Lands in Quabbin Reservoir and Ware River Watersheds - 2000

Chapter 61 Program	*No. of Properties*[1]	*Total Acres*
61 (Forest Lands)	142	5,883
61A (Agriculture)	177	4,976
61B (Recreation/Conservation)	20	562

Source: (MDC/DWM-GIS, 2000)

[1] The number of Ch. 61 participants will be considerably smaller than the number of properties reported because many owners include more than one parcel within a management plan.

In 1995, the Division started a program of direct technical assistance to forest landowners at the Wachusett Reservoir watershed, where nearly 50,000 acres of unprotected forest lands existed. The Division hired a Private Lands Forester, with funding provided jointly by MDC/DWM and the USDA Forest Service (in conjunction with the Department of Environmental Management). The need for a Private Lands Forester had been noted in the past two Quabbin land management plans. This forester assisted DEM foresters in administering M.G.L. Chapter 132, (the Forest Cutting Practices Act) on the Wachusett watershed. In addition, duties included outreach to private landowners to encourage land protection through programs such as Chapter 61 and the Forest Stewardship Program. The Division also encouraged general use of its Best Management Practices for forestry operations on watersheds, as is recommended in the 1991 Watershed Protection Plan for both the Quabbin Reservoir and Wachusett Reservoir watersheds. The Private Lands Forester worked to encourage private landowners to manage their forests and wildlife to meet watershed-wide goals, looking beyond their individual property boundaries and designing management strategies that address the issues of the larger ecosystem.

In order to increase landowner participation in Chapter 61 and the Stewardship programs, the Division contracted to hire private consultant foresters to complete forest management plans for landowners wishing to gain entry into these programs. In FY 95, $40,000 was dedicated to completing plans for approximately 2,000 acres of private forestland and to cost-share practices that benefit the watershed, such as tree planting and erosion control on roads. DWM's technical assistance to landowners to date has resulted in the addition of several hundred acres to Chapter 61, and the completion of forest management plans on 3,000 acres.

While the full-time private lands forester position ended in 1998, DWM staff has continued to perform outreach and forest management plan funding in the three watersheds to encourage good practices and to aid in entering the Forest Stewardship and Chapter 61 programs.

North Quabbin Regional Landscape Partnership

In 1997, DWM staff joined the newly formed North Quabbin Regional Landscape Partnership (NQRLP). The NQRLP is a coalition of federal and state land management agencies, conservation groups, and concerned citizens whose stated mission is "to identify, protect, and enhance strategic, ecological, cultural, and historic open space within the rural landscape of the North Quabbin Region. The North Quabbin Region contains areas within both the Quabbin Reservoir and Ware River watersheds. DWM's membership in the partnership enhances MDC/DWM's land protection efforts by identifying collaborative land protection opportunities and by preventing possible land protection conflicts, such as public access issues. The DWM has been involved with the North Quabbin Regional Landscape Partnership to help minimize problems that may occur due to the different missions of the various agencies, municipalities, and non-profits who manage permanently protected lands in the Quabbin Reservoir and Ware River watersheds.

4.4.2 Assessment

Over the years, various agencies, private organizations, and towns purchased lands in the watershed system and placed them under permanent protection from development. In addition, numerous individuals agreed to the land use restrictions of the Chapter 61 program in exchange for property tax benefits. The preserved and restricted conditions of these lands, and their quantity, make such lands a valuable and significant component of protecting the long-term water quality of Quabbin Reservoir.

Chapter 61 lands are also important to long-term water quality, as they represent permanently vegetated lands that will not be developed. However, due to their ability to be reversed and the fact that some agricultural activities are of potential concern, these lands must be considered as another category. The Chapter 61 program protects listed lands from future urbanization, but Chapter 61A lands may still be of concern due to potential for pathogens and nutrients associated with agriculture. (DWM has implemented the agricultural BMP program to address such concerns; see **Section 6.2**.)

4.4.3 Control Approach

4.4.3.1 Goals

DWM's goals are: 1) for protected land owners to maintain their property in an undeveloped state, and 2) to encourage the development of stable forest cover, where suitable and consistent with owner's goals. By maintaining the protected lands as undeveloped and ideally as forest, DWM reduces the urbanization potential of the watersheds and provides vegetative buffers with water quality protection value.

4.4.3.2 Five-Year Objectives

DWM identified the following objectives for additional protected lands in the next five years:

1. Maintain an up-to-date inventory of additional protected lands, including identification and evaluation of their land management practices.

2. Maximize the watershed protection value of lands owned and managed by DEM and MDFW.

3. Ensure that watershed towns are following proper land management practices on conservation and town forest properties.

4. Keep existing Chapter 61 lands in that status, encourage listing of additional lands to remove such lands from the potential development pool, and assess any lands that change status for possible MDC/DWM acquisition.

5. Work with DEM to continually improve and enforce standards for forestry BMPs (as was recently accomplished with revised, stricter standards).

6. Investigate acquiring interest in other protected open space.

4.4.3.3 Activities

1. Maintain an up-to-date inventory of additional protected lands. Conduct site visits to each of the key properties; identify and evaluate their land management practices. Provide suggestions for improvements if needed.

2. Maximize the watershed protection value of lands owned and managed by MDFW and DEM.

3. Ensure that towns are following proper land management practices on conservation and town forest properties.

   a. Conduct an inventory of town land management practices.

   b. Through the Community Technical Assistance program (**Section 5.3**), provide guidance and education to improve such practices.

   c. Conduct follow-up assessments on any problem properties.

4. Keep existing Chapter 61 lands in that status, encourage listing of additional lands to remove such lands from the potential development pool, and assess any lands that change status.

   a. Evaluate the priority of MDC/DWM acquisition of any protected land that has a status change during the next five years.

   b. Periodically track, through available maps and databases, the additional preserved lands. Identify any trends or significant changes in Chapter 61 lands.

5. Confirm that private forest lands are harvested in compliance with state regulations.

   a. Continue to implement the MDC/DWM's Private Land Forestry program, including additional outreach to the 600 private landowners (owning an estimated 32,000 acres of undeveloped forest land) on the watershed. Within this program, send an annual newsletter, fund forest management plans for certification or recertification in the Chapter 61 program, and encourage the use of BMPs via a green certification program (as was completed for MDC/DWM's Quabbin Reservation holding).

   b. In concert with DFA and local boards, assess activities on Chapter 61 lands to ensure that all state required forestry BMPs are followed, at a minimum.

6. Investigate acquiring an interest, via conservation restriction, in target preserved open space properties.

   a. Investigate legality of holding conservation restrictions on municipal land.

7. Continue involvement and support of the NQRLP and resulting collaborative efforts on land protection projects in the watersheds.

Section 5

Watershed Control Through Regulation and Education

In addition to the 57% of the Quabbin Reservoir watershed (excluding the reservoir) and 37% of the Ware River watershed directly protected by virtue of ownership, significant regulations are in place to protect the watershed system from any potential polluting activity. This section describes the protection afforded by the MDC's Watershed Protection regulations, MDC/DWM's land use regulatory authority under the Watershed Protection Act (WsPA). MDC/DWM's staff work to ensure maximum water quality protection from Federal, State and local regulations via communication and cooperation with Federal and State regulatory agencies and local boards.

Section 5.1 describes the MDC's Watershed Protection regulations in general, and the WsPA, in particular, including which lands are covered by the Act and how it effectively controls development. The Watershed Protection regulations set forth a comprehensive scheme to regulate land use and activities within certain critical (i.e., environmentally sensitive) areas of the watersheds and watershed system. **Section 5.2** summarizes how the body of Federal and State regulations control improper use and development of lands and waters, and how DWM promotes and aids enforcement by responsible agencies. **Section 5.3** describes how local regulations play an important role in managing land development and DWM's Community Technical Assistance program, in which DWM helps towns to conduct local planning, to improve regulations, and to respond to individual applications. Because effective regulation requires the participation of watershed residents and visitors, DWM's Public Education program is included in **Section 5.4**.

5.1 MDC's Watershed Protection Regulations

Accomplishments:

- Achieved passage of the Watershed Protection Act (WsPA) in 1992.
- Completed extensive watershed mapping of the Quabbin Reservoir and Ware River watersheds including parcel delineation and ownership as well as enhanced wetlands coverage from the best available information.
- Completed the 1994 streamlining of various MDC regulations into the MDC's Watershed Protection regulations (350 CMR 11.00) – a comprehensive approach to regulate land use and activities within certain critical areas of the Quabbin Reservoir watershed and the Ware River watershed.
- Fully implemented Act, including promulgating regulations, developing forms and procedures, and conducting a major public outreach effort.
- DWM's full implementation of the MDC Watershed Protection regulations prohibits, restricts, or controls many land use activities within the drinking water supply watersheds on both MDC/DWM lands and private lands.

Assessment:

- WsPA provides significant control to DWM regarding land uses and activities in the Primary and Secondary Protection Zones in the watersheds, totaling 21,835 acres, all of which are critical lands contiguous to mapped tributaries and the reservoirs.
- MDC's Watershed Protection regulations (350 CMR 11.00) provide extensive watershed protection controls on activities both within MDC/DWM managed lands and waters and on private lands in the Quabbin Reservoir and Ware River watersheds.

Key Activities:

- Continue to implement the land use controls found in the MDC's Watershed Protection regulations following the framework of protection, prevention, and remediation.
- Continue to administer the WsPA and work with the watershed communities.
- Update tools such as WsPA Guidance Document.
- Continue public awareness efforts regarding watershed protection.

The MDC's Watershed Protection regulations provide watershed-based public water supply protection. The WsPA greatly expanded MDC/DWM's ability to control development in critical watershed areas. A total of 21,835 acres are directly under MDC/DWM's WsPA authority.

5.1.1 Program to Date

5.1.1.1 History

Prior to the passage of the WsPA of 1992, the MDC/DWM had generalized regulatory authority over activities and land use on privately owned lands in the watersheds. Activities that would degrade water quality were forbidden, but formal mechanisms to exercise this authority were lacking. Following a period of active real estate development and generally increased awareness of water quality impacts, environmental groups and others approached Representative David Cohen in 1987 with a request to initiate legislation to protect the water supply of metropolitan Boston. The resulting proposed legislation, widely known as the "Cohen Bill" was debated and revised in public meetings in the watersheds, in the press, and in State legislature committees over several years. The bill was viewed with concern by many officials and citizens in the areas to be regulated, while considered to be a practical necessity by water supply proponents and metropolitan area officials. By the time of adoption of the 1991 Quabbin Reservoir/Ware River Plan, the Cohen Bill still had not been passed nor had the MDC's Watershed Protection regulations been promulgated.

5.1.1.2 Current Program and Accomplishments

1991 Plan

The 1991 Plan proposed enacting statewide legislation for watershed protection in critical areas. Such legislation was to include funding for acquisition of critical lands and land use restrictions to protect critical areas. It also included authorization to promulgate regulations to enable DWM and DEP to regulate the use of land in critical areas and to respond to violations.

Status

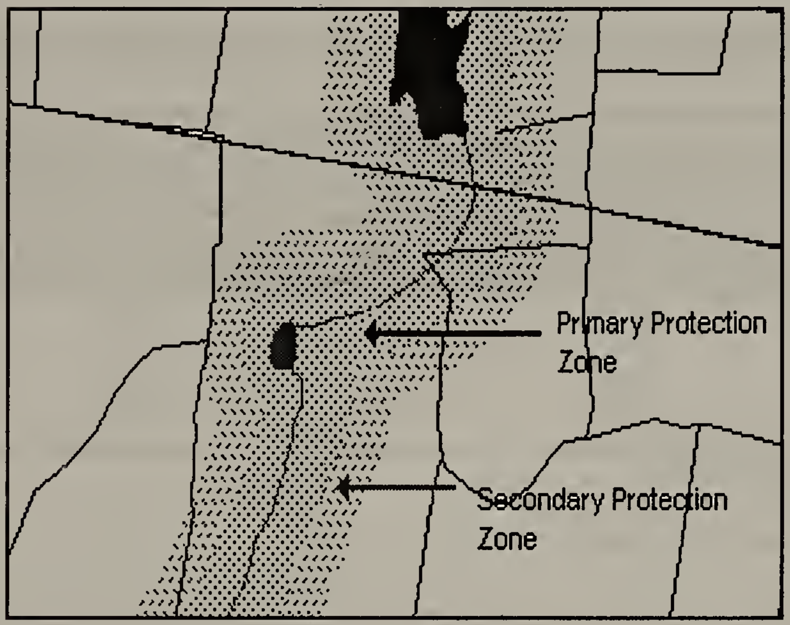
Passage of the Cohen Bill in 1992, known as the WsPA, and the subsequent promulgation of the MDC's Watershed Protection regulations in 1994, accomplished all these goals. The Act provides funding for an extensive program of land acquisition (see **Section 4.1**). It authorizes promulgation of regulations to protect water supplies by both DWM and DEP. The heart of the Act sets forth land use restriction provisions establishing two regulated areas.

Watershed Protection Act (WsPA)

The Watershed Protection Act (WsPA) establishes a system of regulation of specific land uses and activities within critical areas of the Quabbin Reservoir, Ware River, and Wachusett Reservoir watersheds located in central and western Massachusetts to protect the quality of the water supply. The two areas are protected in different ways. Within 400 feet of the reservoirs and 200 feet of tributaries and surface waters (the "Primary Protection Zone"), any alteration is prohibited. "Alteration" includes a variety of activities, such as construction, excavation, grading, paving, and dumping. **Figure 5-1** illustrates how the Act applies to an example property with a WsPA-protected tributary running through it.

Figure 5-1

Watershed Protection Act protected tributary



Certain activities are specifically prohibited between 200 and 400 feet of tributaries and surface waters, and on land within floodplains, over some aquifers (in the Wachusett Reservoir watershed), and within bordering vegetated wetlands (the "Secondary Protection Zone"). These include storage, disposal, or use of toxic, hazardous, and other materials that can pose a threat to water quality (in amounts greater than normal household use); alteration of bordering vegetated wetlands; and development above a certain density.

All development in these areas is regulated with certain exemptions. The most common exemptions are: existing structures and activities, a single-family dwelling on an existing vacant lot, minor changes to an existing structure, and subdivision of an owner-occupied existing parcel to create one additional building lot for a single family dwelling. Many exemptions are subject to qualifications; for instance, an expansion is exempt only if it does not degrade water quality.

Owners who know or believe their land may be affected by the law can ask for an advisory ruling as to the effect of the law on a specific parcel or proposal, a determination of applicability, a variance, or where warranted, exemption of a tributary or portions thereof from the law. **Appendix D** contains updated brochures detailing the WsPA and the WsPA Guidance Document used in its application.

Figure 5-2 maps the Primary Protection Zone and Secondary Protection Zone in the watersheds. A total of 21,835 acres, all of which are critical lands contiguous to tributaries, are protected by the WsPA in the communities wholly or partially in the Quabbin Reservoir and Ware River watersheds, as listed in **Table 5-1.**

Implementation

Following passage of the Act, the DWM undertook an extensive implementation program. In addition to preparing the regulations, DWM undertook a detailed analysis to determine which specific properties are regulated under the WsPA. DWM, MWRA, and Mass GIS used USGS quadrangle maps, USGS Water Resource Atlases, and FEMA flood hazard boundary maps for protected water resource identification. Then, parcel boundaries were digitized from local assessors' maps, and maps of affected parcels were prepared for each town. In addition, assessors' information, such as ownership, was collected for each parcel and organized in a database.

Table 5-1

Acreage of Critical Lands Protected under WsPA
Quabbin Reservoir and Ware River Watersheds, 2000

	Acreage Affected by WsPA[1]			
Watershed	*Primary Protection Zone*	*Secondary Protection Zone*	*Total*	*Percent of Watershed*[2]
Quabbin Reservoir	5,320	5,691	11,011	11.5%
Ware River	5,584	5,240	10,824	17.5%
Total:	**10,904**	**10,931**	**21,835**	**13.9%**

Source: (MDC/DWM-GIS,2000)

[1] Excluding MDC/DWM owned lands.

[2] Watershed area excludes reservoir area.

Figure 5-3 is an example of a WsPA town map identifying affected parcels, in this case for Hubbardston, Massachusetts. These maps have been distributed to each town hall to help residents and local officials determine if they need to file a WsPA application with DWM. In total, the WsPA currently affects approximately 1,260 parcels within the Quabbin Reservoir watershed and 2,221 parcels within the Ware River watershed. **Table 5-2** below lists the number of currently affected parcels by town in each watershed along with the acreage affected by the WsPA's Primary and Secondary Protection Zones.

Table 5 - 2

Parcels Affected by WsPA in the Quabbin Reservoir and Ware River Watersheds, 2000

Town[1]	*No. of affected Parcels in Quabbin Reservoir Watershed*	*No. of affected Parcels in the Ware River Watershed*	*Total WsPA Acreage*	*% of Town*[2]
Athol	4	***	3	0.0%
Barre	105	28	890	3.1%
Belchertown	0	***	0	0.0%
Hardwick	15	***	93	0.4%
Hubbardston*	***	1,068	4,499	16.8%
New Salem	275	***	1,315	4.5%
Oakham	***	6	57	0.4%
Orange	147	***	482	2.1%
Pelham	1	***	2	0.0%
Petersham	413	***	5,951	16.7%
Phillipston	102	360	2,420	15.3%
Princeton*	***	62	526	2.3%
Rutland*	***	464	2,120	9.2%
Shutesbury	112	***	896	5.2%
Templeton	***	150	982	4.7%
Ware	0	***	0	0.0%
Wendell	86	***	651	3.2%
Westminster*	***	83	948	4.0%
Total	**1,260**	**2,221**	**21,835**	***

Source: (MDC/DWM-GIS, 2000)

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[1] Towns wholly or partially in the Quabbin Reservoir watershed and/or Ware River watershed.

[2] Percentage excludes reservoir area.

* These communities also have some affected parcels in the Wachusett Reservoir watershed which are not included in this table.

*** Not applicable

DWM also undertook a significant public communication program to keep landowners, local officials, and state agency personnel up-to-date on the progress of implementation and interpretation of the Act. DWM used the WsPA affected parcel database, developed through watershed mapping, to send over 2,300 letters notifying land owners that their properties were affected by the WsPA in the Quabbin Reservoir and Ware River watersheds. Rounds of meetings were held to discuss the initial WsPA mapping effort, a discussion draft of the WsPA regulations, the proposed draft of regulations, and the aftermath of the owner notification process. Following adoption of Watershed Protection regulations in 1994, and notification of landowners affected by the WsPA, later that year, open houses were held in various communities to answer questions from residents and officials. A staff of five planners, at the Quabbin and Wachusett Sections and at MDC/DWM headquarters in Boston, was hired to work with watershed communities and residents on applications (and other forms of technical assistance).

An important element of WsPA implementation was MDC/DWM staff's increased contact with the town boards, who oversee many local land use regulations (see also **Section 5.3**). Working within the project review process at the local level has made the application and permitting process clearer and more streamlined for both applicants and review boards. DWM's Environmental Planning and Environmental Quality sections, along with staff from other sections when needed, work together to review the WsPA applications, to conduct site visits, and to make recommendations to the superintendent on the disposition of applications.

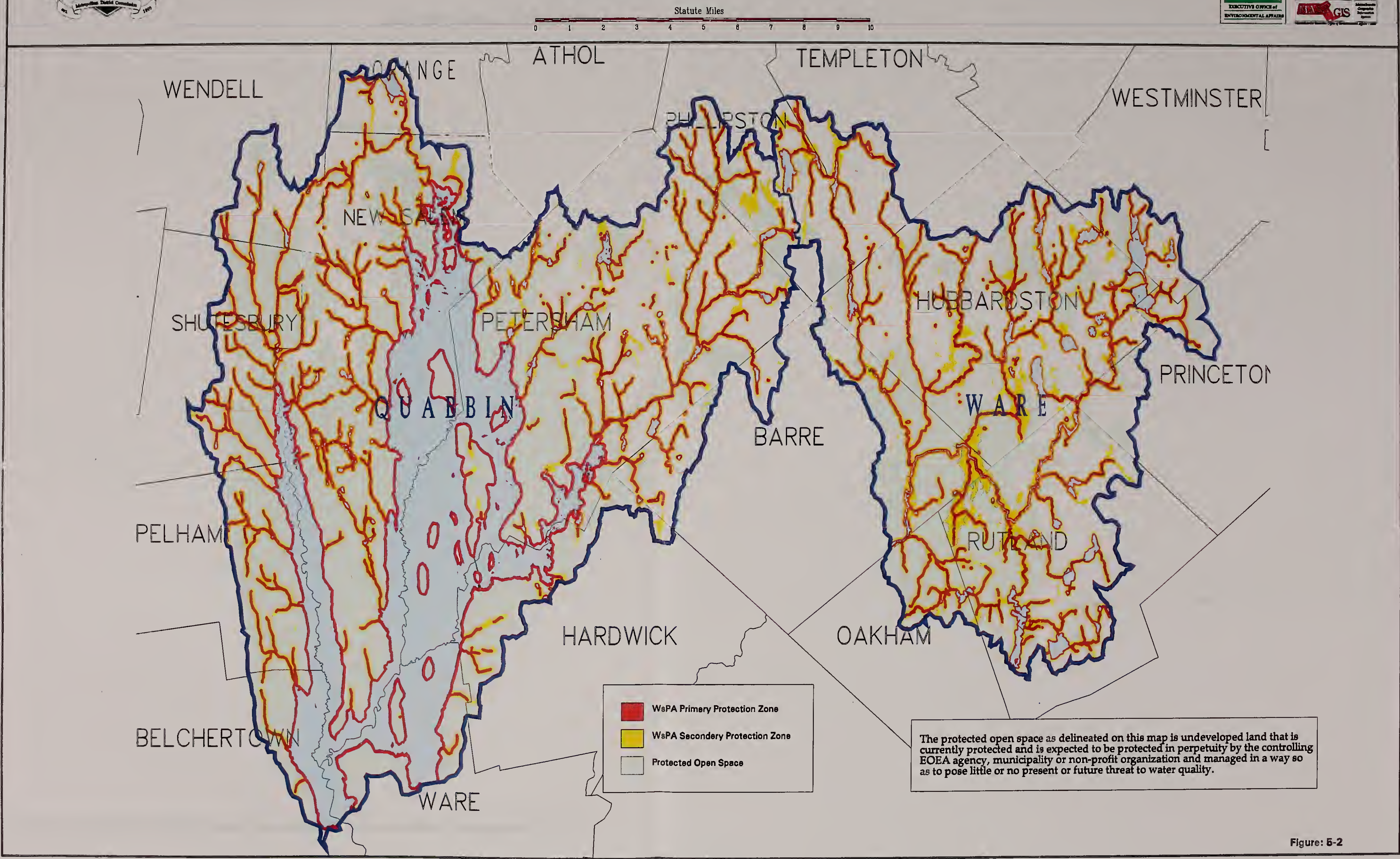
MDC

Watershed Protection Act Regulatory Jurisdiction

Primary and Secondary Zones of Protection

EXECUTIVE OFFICE of ENVIRONMENTAL AFFAIRS

MassGIS


Statute Miles
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WENDELL
ORANGE
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TEMPLETON
WESTMINSTER
PHILLIPSTON
NEW SALEM
SHUTESBURY
PETERSHAM
HUBBARDSTON
PRINCETON
QUABBIN
WARE
BARRE
PELHAM
RUTLAND
HARDWICK
OAKHAM
BELCHERTOWN
WARE
🟥 WsPA Primary Protection Zone
🟨 WsPA Secondary Protection Zone
☐ Protected Open Space

The protected open space as delineated on this map is undeveloped land that is currently protected and is expected to be protected in perpetuity by the controlling EOEA agency, municipality or non-profit organization and managed in a way so as to pose little or no present or future threat to water quality.

Figure: 5-2

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Watershed Protection Act Regulatory Jurisdiction

Town of Hubbardston

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KILOMETERS
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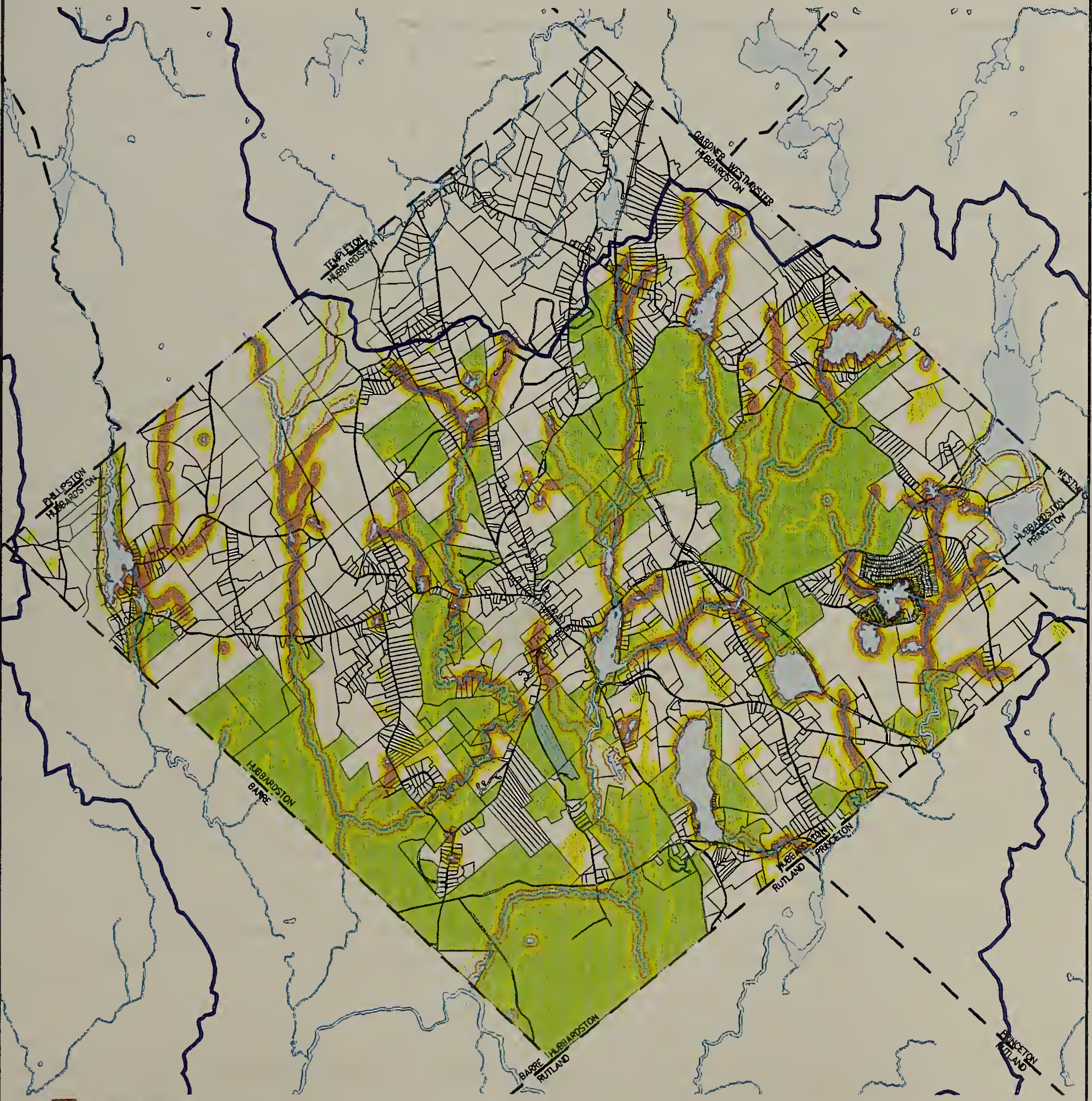
GARDNER WESTMINSTER
HUBBARDSTON
TEMPLETON
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WESTMIN
HUBBARDSTON
PRINCETON
HUBBARDSTON
BARRE
HUBBARDSTON
PRINCETON
RUTLAND
BARRE
HUBBARDSTON
RUTLAND
PRINCETON
RUTLAND

🟧 WsPA Primary Protection Zone

☐ WsPA Secondary Protection Zone

🟩 MDC/DWM Holdings

🟦 MDC/DWM Conservation Restriction

☐ Other Protected Open Space

Ware River Watershed Boundary

Town Boundary

Active Railway

Assessor Lot Line

Figure: 5-3

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Over the past six years, DWM has made great strides in its relations with watershed communities and residents. The opposition vocalized during the WsPA hearings has been largely transformed into a positive working relationship.

5.1.2 Assessment

WsPA and Technical Assistance Improve Proposed Projects

An example of DWM's work with developers and local boards is a 109-lot subdivision that had been approved prior to passage of the WsPA, thereby exempting the lots from the full effect of the Act. DWM worked with the developer and the local planning board through the WsPA's variance process to redesign the subdivision so that the site design protected the tributaries and riparian area, permanently protected open space, and reduced development costs – a win-win situation for all.

The guiding principle of watershed management is that undisturbed land, in its natural state, produces the best water quality. Three main concerns arise from land development. First, the development process can introduce sediment from erosion, and nutrients into tributaries; second, disturbing the land and vegetation can adversely affect local hydrologic processes; and third, land development may have potential long-term impacts on tributary water quality. Fortunately, the potential for such impacts can be limited by planning, design, and construction measures, which can include erosion and/or sedimentation control practices implemented during construction phases to help protect against adverse water quality impacts.

Fully implemented since early 1995, the WsPA allows an opportunity to intervene in many of these developments with a reasoned and predictable process, halt damaging development, and ensure that less damaging alternatives are chosen.

The WsPA resulted in many instances of more sensitive land development. Residential areas have been developed less densely, individual homes have been pulled back from resource areas and commercial and industrial projects have been revised to include mitigation measures to protect water supply tributaries. Between 1994-1999, the Division reviewed 233 proposals within the Quabbin Reservoir watershed and 378 proposals in the Ware River (see **Figure 5-4**). Prior to the promulgation of the regulations in 1994, MDC/DWM staff issued approximately 350 advisory opinions[3].

DWM tracks all applications by parcel, type of application, and various land use categories. These applications represent parcels varying in size from one-acre house lots to 200 acre farms. For 1997 through 1999, the most common land use/activity types were for the construction of single-family residences (30.1%), determination of the WsPA's jurisdiction on a parcel (18.5%), and residential accessory/other uses to single family dwellings (18.2%). **Table 5-3** summarizes the proposed activity types requested on WsPA applications (e.g., residential or commercial activity). DWM staff works with landowners in each of the cases tabulated in **Table 5-3** to ensure that all proposed activities in regulated areas are in compliance with the Act. **Figure 5-5** shows the WsPA application types (e.g., WsPA Determination or Variance) received between 1997-1999.

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[3] Between the passage of the WsPA and promulgation of the regulation, advisory opinions were the only kind of application possible.

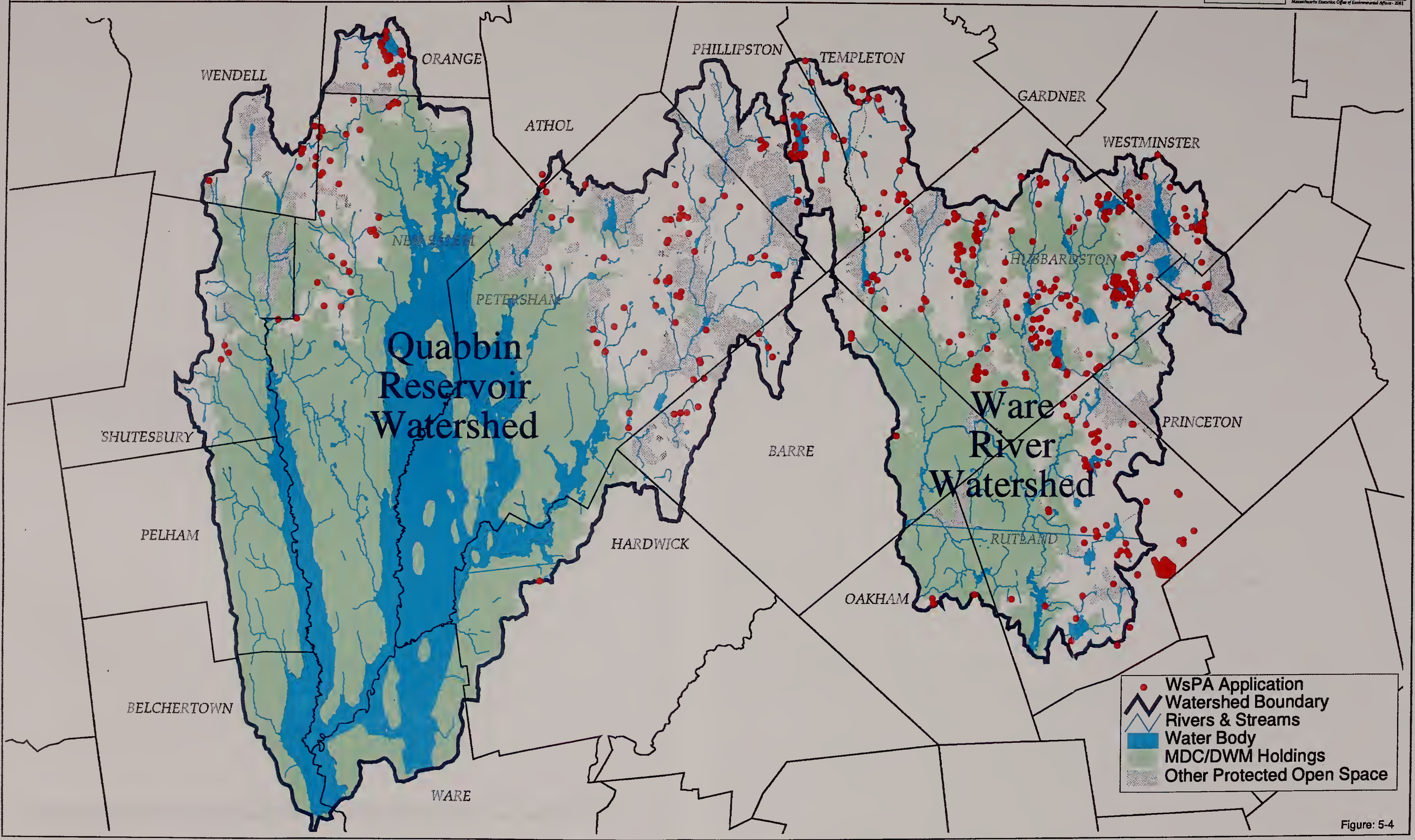
Table 5-3

Summary of WsPA Applications by Proposed Activity (1997-1999) Quabbin Reservoir and Ware River Watersheds

Activity	*WsPA Applications*	*Percent of Total Applications*
Residential – Single-family dwelling	73	30.1%
WsPA Jurisdiction	45	18.5%
Residential – Accessory/Other	44	18.1%
Residential – Additions	18	7.4%
Septic Repair	17	7.0%
Other	9	3.7%
Residential Single-family dwelling reconstruction	8	3.3%
Subdivision – minor	8	3.3%
Commercial	6	2.5%
Right-of-Way – Utilities	5	2.1%
Agriculture – new operations	4	1.6%
Municipal	3	1.2%
Redevelopment – municipal	1	0.4%
Residential – Multi-family	1	0.4%
Subdivision – Major	1	0.4%
TOTAL	**243**	**100%**

Source: (MDC/DWM – Environmental Planning, 2000)

Watershed Protection Act Regulatory Action Tracking Map 1994-1999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WENDELL
ORANGE
ATHOL
PHILLIPSTON
TEMPLETON
GARDNER
WESTMINSTER
NEW SALEM
PETERSHAM
HUBBARDSTON
Quabbin Reservoir Watershed
Ware River Watershed
SHUTESBURY
BARRE
PRINCETON
PELHAM
HARDWICK
RUTLAND
OAKHAM
BELCHERTOWN
WARE
● WsPA Application
Watershed Boundary
Rivers & Streams
Water Body
MDC/DWM Holdings
Other Protected Open Space

Figure: 5-4

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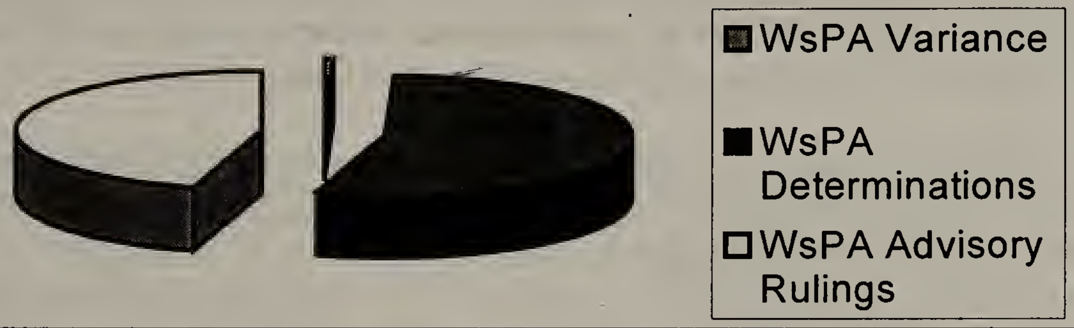
Figure 5-5
Watershed Protection Act (WsPA)
Applications, 1997-1999



Source: (MDC/DWM Environmental Planning, 2000)

5.1.3 Control Approach

5.1.3.1 Goals

MDC/DWM staff will continue to implement, enforce, and uphold all the provisions of the MDC Watershed Protection regulations (350 CMR 11.00) through a variety of general and specific programs as well as special projects, as needed.

The implementation program of the WsPA has several goals. The primary goal is prevention of water quality threats from development in the most critical areas of the active MDC/DWM water supply watersheds. MDC/DWM staff also strive for fair and consistent application of the regulations, and timely review and decision concerning applications. Another goal is to use the regulations to educate landowners and town officials concerning the effects of individual development projects on water quality, and measures to mitigate these effects, even outside of the regulated area.

5.1.3.2 Five-Year Objectives

DWM has identified specific objectives for the coming five-year period.

1. Within the next five years, DWM's primary objective is to continue to implement, enforce, and uphold all provisions of the Watershed Protection regulations and the WsPA.

2. As a secondary objective, DWM aims to continue to enhance coverage and awareness of the WsPA, improve effectiveness and consistency of administration, avoid duplication of effort or inconsistencies when projects are reviewed by municipal boards and other state agencies, and establish and articulate interpretations of the regulations for internal use and for communication to local officials and the regulated public.

5.1.3.3 Activities

1. DWM will continue to implement the MDC Watershed Protection regulations on MDC/DWM controlled lands and waters and private lands and waters in the watershed system.

2. DWM will continue to administer individual WsPA applications under 350 CMR 11.00. Such administration requires contacting applicants, reviewing projects, visiting sites, conducting variance hearings, issuing decisions by the Superintendent, handling appeals, and post-decision monitoring.

3. To promote consistency and fairness of implementation, involved staff will continue to meet regularly as the WsPA Implementation Working Group. As specific issues arise, the Working Group and Divisional staff will continue to develop internal policies and criteria, apply regulations using legal research and best available information, and consult with other agencies.

4. The Working Group will continue to refer projects to the Environmental Quality section and the Superintendent. These referrals include projects that are not regulated by WsPA but fall under the MDC's Watershed Protection regulations and require monitoring due to potential water quality impacts, and projects covered by WsPA that also are subject to other regulatory procedures (such as local Conservation Commission approval).

5. Continue to educate and interact with local boards (e.g., Planning Boards and Boards of Health) about Watershed Protection regulations and the WsPA provisions, by participating at meetings of these volunteer boards, as well as through informal discussions.

6. DWM will also maintain and update the technical tools of regulatory implementation such as WsPA forms for applications and the WsPA Guidance Document for applicants and landowners.

5.2 Major Environmental Regulations

Accomplishments:

- DWM assisted in identifying potential violations, conducting site visits, collecting data, and working with regulatory authorities and landowners to attain compliance.
- Finalized DWM and DEP-CERO Standard Operating Procedures for joint compliance and enforcement activities.

Assessments:

- Since 1991, major revisions and new state regulations have been promulgated. These include Wetlands Protection Act, Title 5, the Rivers Act and Regulations, DEP Stormwater Management Policy, and MEPA regulations achieving greater environmental protection within the watersheds.
- At the policy level, DEP also has developed its own internal Enforcement Response Guidelines.

Key Activities:

- Continue to implement DWM-DEP Enforcement Protocol.
- Maintain active presence in watersheds.
- Continue coordinating with landowners, municipalities, and regulatory agencies.

The Commonwealth of Massachusetts, as well as U.S. Environmental Protection Agency (EPA), have a broad range of laws and regulations, collectively aimed at reducing and controlling environmental pollution. **Table 5-4** summarizes key laws and regulations, their relevance to watershed protection, and the enforcement authority.

These laws and regulations apply throughout the Quabbin Reservoir watershed and Ware River watershed and act as a significant control against potentially polluting activities on private lands. This section discusses the protection afforded by this body of laws, their enforcement within the Wachusett watershed, and DWM's role in enhancing their administration and enforcement.

5.2.1 Program to Date

5.2.1.1 History

Prior to adopting the 1991 WPP, DWM had only an occasional role in the enforcement of federal and state laws addressing water quality threats from watershed activities. DWM staff did perform some watershed monitoring and surveillance. Although state agencies hold authority and responsibility for enforcement, DWM staff would often become aware of such problems due to the Division's on the ground presence and other pollution prevention activities in the watershed. Violations and other problems were handled by personal contact and letters notifying owners of violations under 350 CMR 11.00, which is MDC's Watershed Protection regulations. Generally, enforcement was handled at this less formal level and on a case-by-case fashion, as need arose and information was obtained. Staff coordinated with DEP and other agencies on particular projects or sites that were of strong interest, but there were not enough staff to have widespread coordination or a formalized process for enforcement.

Table 5-4

MA State Laws and Regulations Providing Watershed Protection

Authority	*Law/Regulation*	*Relevance*	*DWM Role*
DEP*	Title 5	Regulates the siting (e.g. distance away from water resource), design, and inspection of on-site systems; provides a method for gradually attaining adequate function from existing systems (via inspection at property transfer).	DWM continues an active role addressing Title 5 compliance, as well as addressing problem systems currently unaffected by Title 5 (see **Section 6.3**).
DEP**	Wetlands Protection Act	Restricts the alteration and/or filling of wetlands; requires review of all projects within 100 feet of wetlands or within floodplains.	Through Community Technical Assistance (**Section 5.3**), DWM is helping boards to implement these regulations.
DEP**	Rivers Protection Act	Establishes buffer zones around rivers and streams with these buffers; development criteria apply.	Through Community Technical Assistance (**Section 5.3**), DWM is helping local boards to implement these regulations.
DEP**	Stormwater Management Policy	Addresses stormwater from development projects under the existing WPA; addresses Notice of Intent process.	Through Community Technical Assistance (**Section 5.3**), DWM is helping local boards to implement these regulations.
DEP	Water Quality Standards and Certification	For any project needing a federal dredging, filling, or discharge permit, requires certification that no water quality standards will be violated.	DWM monitors tributaries and reservoir; when standards are not met, DWM works to resolve.
DEP	Solid Waste Regulations	Regulates the siting, design, and operation of solid waste facilities, including restrictions on location near water supplies; requires capping and monitoring; requires closure of unlined landfills; requires operations to discourage birds/gulls.	DWM has played a significant role in the closure of the landfills within the watersheds. DWM now receives and reviews monitoring data from the closed facilities.
DEP	Mass Contingency Plan (MCP)	Establishes a process for prioritization, investigation, and cleanup of hazardous materials.	DWM monitors all MCP site status and cleanups; and in some cases, works with landowners to ensure MCP is followed.
DEP	Underground Storage Tank Regulations	Regulates design and construction of new or replacement underground tanks.	DWM obtains registration information for large tanks during sanitary survey, and works directly with landowners on any tank problems.
DEP	Surface Water Discharge Permit Program	Regulates discharge of pollutants to surface waters; regulates outlets for such discharges and any treatment works associated with these discharges.	DWM monitors applications for permits in the watersheds.

Table 5-4 (continued)
State Laws and Regulations Providing Watershed Protection

Authority	*Law/Regulation*	*Relevance*	*DWM Role*
DEP	Groundwater Discharge Permit Program	Regulates discharges of pollutants to groundwater; regulates outlets for such discharges and any treatment works associated with these discharges.	DWM reviews permits and monitoring reports.
DEP	Massachusetts Water Management Act Program	Requires that withdrawals of water above a threshold quantity are registered and regulated	DWM receives notification through MEPA filing.
DEM	Forest Cutting Practices Act and regulations 304 CMR 11.00	Requires filing of a cutting plan; mandates unaltered buffer strips; provides operations standards including stream crossings; monitoring conducted by Service foresters.	DWM conducts site inspections on selected logging operations.
MEPA	MEPA and its Regulations	Requires comprehensive environmental assessment and public review of major projects.	Under the new MEPA regulations, DWM receives all MEPA filings in the watersheds and comments when needed. Any project required a WsPA variance, except for single-family houses, are now required to also file an Environmental Notification Form with MEPA.
DFA	Pesticide Regulations; Rights-of-Way Management Regulations	Restricts type and location of pesticides; requires fling of Vegetative Management Plans and Yearly Operational Plans for Rights-of-Way maintenance.	DWM reviews VMPs and YOPs in the watershed and comments when needed; DWM obtains pesticide use records when investigating a site of concern.

Source: (MDC/DWM Environmental Planning, 1998)

* Administered locally by the town Board of Health.
** Administered locally by the local Conservation Commission

5.2.1.2 Current Program and Accomplishments

The 1991 Quabbin/Ware Plan called for increased enforcement of existing local and state regulations regarding recreation, trash disposal, trespassing, and other activities incompatible with drinking water supply watershed management. As a joint effort among agencies, communities and police, aggressive enforcement of existing statutes and regulations was proposed, including:

- Improving staffing levels and more extensive use of MDC enforcement powers;
- Training State and local police staffs to address environmental crimes;
- Improving coordination with other regulatory agencies to attain better enforcement of their major environmental regulations; specifically, developing agreement mechanisms with DEP to ensure full involvement in regulation and enforcement; and
- Increasing use of MEPA oversight.

In the past five years, DWM increased its role and effectiveness in enforcing Federal and State environmental laws and regulations. A larger, more highly trained staff made closer monitoring possible, resulting in identification of violators. Making best use of its authorities, DWM developed its own enforcement policies in specific subject areas. DWM and DEP worked on an overall enforcement policy for coordination on DEP-enforced regulations. Additionally, DWM staff actively participated in revisions of regulations in process at DEP and other environmental agencies. MEPA regulations also were revised with DWM input and now require distribution to DWM staff for projects in the watersheds.

Inspections and Violation Identification

DWM continued site inspections and sanitary surveys in the Quabbin Reservoir and Ware River watersheds, which was greatly enhanced by additional staff and a wider range of information-gathering activities (including attendance at meetings of local boards and commissions, described in **Section 4.4**). Compliance and enforcement activities now occur at a number of levels. Measures such as individual contact, advance warnings, and notices of violations still occur as they did before, but are now in a more standardized format.

Violations or potential violations discovered by DWM staff are often brought to the attention of other appropriate agencies and local boards. DWM field staff inspections of septic systems yield information given to local Boards of Health (BOH). Where a Title 5 violation is uncovered, the information is given to the relevant DEP regional office.

Mechanisms are pursued to advance these matters to the next enforcement step, if necessary. DWM worked with DEP Central Regional Office (DEP-CERO) to draft a set of standard operating procedures, described below, for enforcement of both agencies' regulations. DWM and DEP-CERO discussed possible enforcement cases with the State Office of the Attorney General (OAG). As of this writing, the OAG successfully won a complaint regarding a violation of the WsPA.

DWM Authority

MDC/DWM's own enforcement authority is governed by MGL Ch. 92, sec. 110. DWM formulated an On-Site Wastewater Systems enforcement policy that is being adapted for use in other threatened areas, such as agriculture.

State Agency Coordination

Enforcement of the State's environmental regulations is an important component of protecting water quality. Many significant Massachusetts regulations are enforced by DEP, and thus it is imperative that DWM encourage and aid DEP enforcement efforts in the watershed. A joint enforcement approach between DEP and MDC was suggested in the WsPA by the Legislature. To set forth the violations that warrant joint enforcement and to provide guidance at the staff level, DWM and DEP-CERO have collaborated on a Standard Operating Procedures document or protocol, for joint compliance and enforcement.

The protocol was finalized in 1999. Key elements of the protocol are agreements about interagency communication regarding suspected violations, joint inspections, designation of the lead agency depending upon jurisdiction and type of violation, access to property, documentation, and procedural specifics. Since the document establishes that MDC's independent enforcement authority is limited to criminal matters, in many cases referral to DEP for civil administrative enforcement will be the preferable course of action.

In addition to the protocol, DWM's work with DEP resulted in interagency training sessions, coordination of specifics of cases that go through regulatory processes at both agencies, and establishment of an ombudsman-type contact at DEP-CERO to assist DWM staff with questions and issues.

DWM exchanged training and information with MEPA staff as well, advising on how to include WsPA and other watershed projects in the new MEPA regulations and forms.

Coordination with Local Boards Implementing State Regulations

Local boards are the implementing arms of many of the State regulations, at least at the first level of enforcement. The Quabbin Section staff attends meetings of local boards as needed, and in regard to specific cases (local contacts are described further in **Section 5.3**).

5.2.2 Assessment

More staff in all areas have allowed for increased enforcement efforts, creation of formal policies in place of case-by-case approaches, and greater information exchange and coordination with other agencies and local entities.

Since the 1991 Plan, there have been notable achievements to strengthen laws that will help prevent water quality degradation from a range of activities, land uses, and discharges. These improvements include stronger DEP regulations for siting and maintaining on-site wastewater disposal (Title 5), establishment of protective buffers around rivers (the Rivers Protection Act and Regulations), and stormwater BMPs for new construction near resource areas (DEP Stormwater Management Policy, November 1996). At the policy level, DEP also developed its own internal Enforcement Response Guidelines, as well as guidelines for using administrative right-of-entry powers. MEPA revised its regulations, and DFA has revised its pesticide and herbicide application regulations.

DWM remains active through their presence on committees, in the comment process for adoption of new regulations, as well as in revisions for others. In concert, the new regulations and other measures significantly increase DWM's degree of control over the amount, quality, and location of development in the most sensitive areas of the watershed.

5.2.3 Control Approach

5.2.3.1 Goals

DWM's goal is to achieve full use of existing federal and state laws and regulations to protect the water supply. This goal can be broken into four essential components: (1) awareness of regulations by the regulated parties; (2) awareness of the significance of Quabbin Reservoir, Ware River Intake and their watersheds by the responsible individuals in the regulatory agencies; (3) use of DWM's presence in the watersheds (which is greater than other individual agencies can attain) to identify, refer, and follow up on violations; and (4) effective, "lobbying" by DWM regarding enforcement needs.

5.2.3.2 Five-Year Objectives

Within the next five years, DWM's objectives to obtain compliance with and enforcement of major environmental laws include:

1. To pursue widespread compliance with all environmental laws;

2. To assist other agencies with gathering facts and exchanging information;

3. To expedite enforcement of cases that come under both DEP jurisdiction and WsPA or other DWM authority;

4. To increase knowledge at DWM and other agencies of related laws and regulations; and

5. To be aware of regulatory changes, and communicate DWM's views on proposed changes and new regulations.

5.2.3.3 Activities

To accomplish these goals, DWM will do the following:

1. DWM will continue its presence in the watersheds, using a combination of site inspections, sanitary surveys, local board coverage, and Watershed Rangers to identify possible violations of state and federal environmental regulations.

2. DWM will improve coordination with DEP, which has responsibility for many significant regulations, continue implementation of enforcement protocol with DEP, including possible delegation of some inspections and procedures. DEP is currently reviewing this draft document in light of its new Enforcement Response Guidelines, and the two agencies are working toward resolution of questions about how to implement a legal enforcement authority. It has been established that DEP's administrative penalty authority can be used for enforcing the WsPA, but division of labor in enforcement is still to be determined, as are methods for adapting MDC field procedures and reporting for use in DEP enforcement actions.

3. DWM will continue to coordinate with other agencies, exchanging information on specific projects under their jurisdiction, and coordinate with other agencies on review of state projects. Interagency training with DEP on WsPA and related laws will also move forward. DWM will send individual staff to DEP and other professionally sponsored training sessions on Title 5, septic inspections, wetlands delineation, and other state laws.

5.3 Community Technical Assistance

Accomplishments:

- DWM prepared an analysis of local regulations and a handbook with model bylaws.
- DWM funded and/or prepared several local planning efforts, and has presented many workshops to local boards.
- Three towns modified local land use regulations with DWM input.
- Initiated the MDC/DWM "Friend of the Watershed" Award in 1999.

Assessment:

- Through a cooperative approach, DWM effectively improved the land use planning, control of development, and general environmental protection at the local level.

Key Activities:

- Meet regularly with selected municipal boards.
- Provide direct technical assistance support to local boards and community organizations.
- Develop and fund grant program to strengthen local planning and regulatory capabilities.

In the Commonwealth of Massachusetts, municipalities have significant authority over land use and development, subject to the limitations and procedural dictates of State statutes. Towns are authorized to enact and enforce a variety of their own measures, such as zoning bylaws, (affecting the type, location, and density of allowed development); subdivision control regulations, (including performance and design standards for environmental impact); overlay districts, (such as aquifer protection bylaws); and many others. In addition, the State delegated partial authority for regulations such as Title 5 (standards for on-site sanitary waste disposal) and the Wetlands Protection Act to municipal governments.

Volunteer boards, such as the Boards of Health, Conservation Commissions, Zoning Boards of Appeals, and Planning Boards, are responsible for administration of these bylaws and regulations. Tasks that board members must perform include reviewing proposals, commenting, and determining if the applicable standards are met; issuing approvals or permits; and supervising construction and other on-site compliance reviews. In many towns, especially small ones, there are few paid professional positions, and the boards may not have town staff to support them. Further, the board members may or may not have received training in that technical area.

Thus, MDC/DWM's community technical assistance program seeks to maximize the watershed protection afforded by the local and locally delegated controls. DWM has been very active in recent years to function as technical support for these local boards and commissions.

5.3.1 Program To Date

5.3.1.1 History

Local governments are an important part of overall watershed protection since they have authority for and administer a variety of local land use bylaws, State environmental regulations, and State policies (e.g., Earth Removal bylaws, and the Wetlands Protection regulations, and Stormwater Management policy).

Since its formation in the mid 1980s through the early 1990s, DWM has maintained contact with local boards, through the review of major development proposals, construction site inspections, and other situations pertaining to compliance with State and Federal regulations. Through these efforts, DWM helped address a range of water supply threats, such as septic systems, sedimentation from construction, road drainage, stormwater runoff from residential areas, and recreational field runoff.

5.3.1.2 Current Program and Accomplishments

Background

The Quabbin Reservoir and Ware River watersheds fall within the jurisdiction of 18 municipalities, listed in **Table 5-5**. The four towns with the largest watershed areas, representing over 63% of the two watersheds, are Hubbardston, New Salem, Petersham, and Rutland, Massachusetts.

1991 Plan

The 1991 Plan established a goal to "encourage local land use controls." Specifically, the Plan states that:

> "DWM will develop a community assistance program. Model bylaws, zoning amendments and regulations will be developed to help the municipalities in properly implementing a local land use control program. Technical Assistance will also be provided. As part of the program, consideration will be given to providing financial incentives for the development and administration of local regulations to accomplish watershed protection."

The 1991 Plan focused on technical assistance, in part because the passage of the Watershed Protection Act, which would give MDC/DWM direct regulatory authority over land uses and activities in critical zones, was not assured.

The 1993 Addendum to the WPP reiterated the 1991 goal and refined the need for the DWM to "encourage and support the adoption of stronger local bylaws and regulations" and "provide local assistance and develop model bylaws." To establish effective local land use controls, DWM would provide technical assistance and funding.

Table 5-5

MA Municipalities in the Quabbin Reservoir Watershed and Ware River Watershed

Municipality	*% of Combined Watersheds*
Athol	0.1
Barre	5.5
Belchertown	2.1
Hardwick	3.3
Hubbardston	13.1
New Salem	19.3
Oakham	1.6
Orange	1.2
Pelham	3.7
Petersham	22.2
Phillipston	4.1
Princeton	1.8
Rutland	8.4
Shutesbury	4.3
Templeton	2.2
Ware	3.5
Wendell	2.1
Westminster	1.5
Total	**100.0%**

Source: (MDC/DWM GIS, 2000)

Accomplishments

With the passage of the WsPA in 1992 (described in **Section 5.1**), MDC/DWM's involvement in local planning and environmental issues was greatly expanded. The WsPA also required a program of technical assistance for affected communities; specifically to "provide a program for technical assistance to communities impacted by this act," that includes, but is not limited to, "planning studies, and zoning bylaw studies, health bylaw studies and subdivision bylaw studies" (MGL Ch. 92, Sec. 108).

Over the past six years, DWM has greatly enhanced the overall watershed protection efforts by providing valuable technical assistance to municipalities on a range of issues directly and indirectly affecting water quality. As most watershed municipal governments are run by volunteer boards and commissions without professional staff, MDC/DWM staff have worked with them to improve local bylaws and regulations for environmental protection.

DWM's technical assistance encompasses the following types of activities:

1. Growth management planning, master plans, and land use studies;
2. Review, revision, and development of zoning by-laws; subdivision, wetlands, sanitary, and other regulations; protective districts; and performance standards;
3. Refinement of local monitoring, review, permitting, and enforcement practices;
4. Case-specific design and permitting advice to municipal boards or landowners from natural resource, engineering, and planning professionals, including on-site reviews of proposed development projects with local board members and municipal officials;
5. Public education programs, including development of monographs pertinent to watershed management, land preservation and land use planning;
6. Legislative advocacy and participation in working groups that review and make recommendations for improvements to state environmental and planning statutes;
7. Applied watershed management research;
8. Technology transfer; and
9. Coordination of program topics and audiences with other technical assistance organizations (such as watershed associations and DEP circuit riders).

Over $150,000 in direct funding, plus DWM staff time, has been committed to technical assistance through the Environmental Planning and Environmental Quality sections. This outreach has affected many communities in both the Quabbin Reservoir and Ware River watersheds. Specific technical assistance efforts that DWM has conducted are listed in **Table 5-6**. Through these efforts, DWM has: 1) established a familiar and effective presence at local board meetings, (which also assists with implementation of the WsPA); 2) sparked local efforts to improve bylaws, regulations, and procedures; and 3) provided training for local officials.

Value of Technical Assistance

A program of technical assistance helps DWM address the four major challenges to a comprehensive watershed protection program:

1. Support from the communities, as well as individuals and interest groups, is essential to ensure successful implementation.
2. Desire for economic growth and development pressures can conflict with watershed protection goals.
3. Fragmented institutional frameworks can frustrate coordinated watershed management.
4. Commitment of financial resources is needed to accomplish land use planning (part of effective watershed management) in communities with limited financial resources.

Table 5-6.

Examples of Community Technical Assistance
Quabbin Reservoir Watershed and Ware River Watershed Communities

Town	*Project/Workshop*	*Status*
Hubbardston	Design and permitting assistance to Conservation Commission	Ongoing
	Review of existing master plan for Planning Board	Pending
	Participating in writing the Hubbardston Open Space Plan	Near Completion
	Workshop: "Conservation Options for Land Owners", hosted in Hubbardston by Pure Water Stewardship Committee with participation by MDC/DWM	Completed
Princeton	Drafting and review of open space development by-law for Planning Board	Completed
	Assisting the Bentley/MacDonald Land Protection project.	Near Completion
Petersham	Drafting and adoption of new subdivision regulations for Planning Board	Completed
Phillipston	Review of subdivision regulations for Planning Board	Pending
Rutland	Development of town's first Master Land Use Plan, re-writing of zoning bylaw, subdivision regulations, and other protective measures	In progress
	Drafting and passage of Open Space Design Bylaw	Completed
	Drafting and adoption of revisions to subdivision regulations (for Open Space Design)	Completed
	Drafting and adoption of Major Home Occupation bylaw[+]	Completed
	Development, implementation, and analysis of Master Plan Public Opinion Survey.	Completed
	Design and permitting assistance to Planning Board, Conservation Commission, and Board of Health	Ongoing
	Workshop: Development Fees and Subdivision Review Procedures[•] (Host)	Completed
	Workshop: Residential Development – The Price of Growth; What it Costs[•] (Participated)	Completed
	Workshop: Title 5 – Alternative Systems Impact on Land Use Planning* (Participated)	Completed
	Household Hazardous Waste Collections	Completed
	Assistance with local pond association, Demond Pond Association.	Completed
	Workshop: Growth Management – The Pros and Cons of Two Acre Zoning and Cluster Bylaws (Host)	Completed
	Workshop: "Conservation Options for Land Owners", hosted in Rutland by Pure Water Stewardship Committee with participation by MDC/DWM	Completed
Shutesbury	Lake Wyola Drainage Design Study	Completed
Wendell	Dry hydrant design review and installation monitoring (Stone Pond)	Completed
All	Development of monograph on use of Conservation Restrictions	In Progress
	Participation on a legislative subcommittee to advise Local Affairs Committee on revision of M.G..L. Chapter 40A (Zoning Act) and Chapter 41 (Subdivision Control Law)	Ongoing

Source: (MDC/DWM EP, 2000)

[•] Workshops provided through the DWM, topics specifically requested by communities.

[+] Planning study undertaken by the Central Massachusetts Regional Planning Commission, topic identified by affected communities, technical support provided by the DWM.

Presence

Attendance at local board meetings is an effective way to foster good communication between DWM and the watershed communities. DWM presence offers both a regulatory review and the opportunity to provide immediate technical assistance and, if need be, the recommendation for more in-depth consultation.

DWM presence has increased at local board meetings; staff attend selected Planning Board, Board of Health and Conservation Commission meetings monthly or twice-monthly. DWM staff may attend other meetings, such as Board of Assessors or Board of Selectmen, upon request or when there are particular agenda items important to DWM.

Bylaws

DWM funded and distributed two manuals on municipal bylaws and regulations for watershed protection. The first was: *"Watershed Protection for Towns: A Guide to Bylaw Adoption"* (Willmer, 1993*)*, a review of procedures for adopting local watershed protection bylaws and regulations in Massachusetts, and a collection of model bylaws and regulations for watershed protection. The second was: "Watershed Protection for Towns: Analysis of Existing Bylaws" (Willmer, 1993), a technical review of bylaws specific to local source protection. These two documents were distributed to all watershed communities. Communities wishing to review or update bylaws can directly use these materials, as well as solicit direct assistance from MDC staff.

Following these initial efforts, DWM funded a contract with West Boylston, a Wachusett Reservoir watershed community, to revise the town's Subdivision Regulations. The regulations were approved in March 1998. The model regulations developed from the work in West Boylston have been made available to the consultants working in Rutland, and DWM staff will work with interested towns to modify their subdivision regulations using the model.

Training

Local volunteer boards are responsible for development and land-use rule making and enforcement in both watersheds. These board members often lack access to information regarding both fundamental and innovative techniques to control and guide development and land use. Beginning over five years ago, DWM, with the help of consultants, provided valuable training needed by these local boards to meet the challenge of balancing development with adequate resource protection.

Programs that were presented in the Wachusett Reservoir watershed at local board meetings and to the general public in a variety of forums include techniques for subdivision rules and regulations, erosion and sedimentation control, stormwater management, and stream restoration. Programs of general interest are presented on topics related to wetlands protection, growth management, cost of open space compared to residential or commercial development, and the history of the watershed and development of the reservoirs. Since 1996, a total of 17 workshops have been conducted, reaching over 250 local officials and interested citizens.

Staff use the existing network of active citizens from watershed towns and boards to share information, keeping DWM staff apprised of immediate training and technical assistance needs.

A watershed training program similar to that which has been conducted in the Wachusett Reservoir watershed will be undertaken on a limited scale in the Quabbin Reservoir and Ware River watersheds in selected towns or sub-regions. The emphasis will be on maximizing the effectiveness of local boards in the implementation and enforcement of their own bylaws and regulations.

5.3.2 Assessment

In working with watershed area officials and citizens, DWM successfully found common ground on resource protection issues. DWM stresses that combined efforts help both local resources and the Metropolitan Boston water supply. The technical assistance programs emphasize local source protection and its immediate impact to watershed residents and decision-makers.

Through a cooperative approach, DWM effectively improved the land-use planning, control of development, and general environmental protection at the local level.

5.3.3 Control Approach

5.3.3.1 Goals

DWM's Community Technical Assistance work is aimed at a single goal: to use and improve the watershed protection afforded by local land use control programs.

DWM recognizes the unique "home rule" land use authority vested in Massachusetts municipalities. Most of the specific planning and regulatory tools and techniques that comprise watershed protection (for areas outside direct MDC jurisdiction) must be adopted at the municipal level through town meetings, and enforced by local volunteer boards. Thus, to accomplish the utility goals and to improve local programs for water protection, DWM adopted the role of advocate and advisor.

5.3.3.2 Five-Year Objectives

DWM has the following objective for the community technical assistance program in the next five years:

1. Continue an active presence within watershed communities, specifically at local board meetings, providing professional review and recommendations on matters relating to watershed protection and land use planning.

2. Provide and coordinate training opportunities for local board members and town personnel responsive to needs and relevant to water quality protection and land use planning.

3. Administer and oversee existing technical assistance grants and contracts.

4. Develop, implement, and fund a grants program to provide consistent guidelines for the distribution of DWM's technical assistance funds and to maximize watershed benefits.

5. Coordinate funding and technical assistance with other agencies.

Also, DWM will establish and maintain a resource center within the Division Field Headquarters at John Augustus Hall in West Boylston (as described in **Section 5.4**, Public Education). The resource center will include many reference materials of use to local governments.

5.3.3.3 Activities

DWM will meet its objectives in the next five years through the following activities:

1. Meet regularly with local boards. DWM will continue attending regular meetings of local boards by assigning individual Environmental Planning and Environmental Quality staff to each town board. Environmental Planning staff attend some Planning Board meetings on a regular basis, and others on an as-needed basis. Environmental Quality staff attend selected Board of Health and Conservation Commission meetings on a monthly or as-needed basis.

2. Provide direct technical assistance support to local boards and community organizations. Upon request from communities, through regular contact at board meetings and/or through regulatory review process, offer professional expertise and DWM resources (e.g., project review, contract development, and GIS maps). This type of in-house technical assistance is intended for small projects, whereas large or complex requests would be recommended for outside consultation, with DWM support if possible (see #7 Develop and fund grant program).

3. Track changes in local bylaws for watershed protection. DWM subscribes to a service that reviews local bylaws and issues reports on changes that affect watershed protection.

4. Administer grants and contracts for community planning projects. Continue to monitor current contracts and grants administered by Environmental Planning to watershed communities.

5. Continue to provide input at the state level through the legislative process to revise both the Zoning Act and Subdivision Control Law in a manner such that local regulatory mechanisms may be strengthened relative to watershed protection.

6. Continue to research and produce monographs on selected topics relative to watershed protection.

7. Develop and fund grant program to strengthen local planning capability.

    a. DWM staff will work with municipalities to identify projects with common interests. DWM will identify the greatest needs, in terms of watershed community bylaws, and help towns scope projects.

    b. The current technical assistance program services the watershed communities based on a combination of "first come/first served" requests by the community matched with the availability of funds. The establishment of a formal grant program, including an application and selection process and set amount of money, will provide continuity to the technical assistance provided by DWM.

       In the next five years, DWM will design and implement a formal grant program. The grant program will primarily use a "Master Grant" style of reimbursement with the towns, allowing the municipalities to administer the contracts for the requested technical assistance.

    c. Once a grant program has been established, DWM will request and allocate funding for the program at an estimated level of $200,000 per year, and will provide necessary administration and oversight. At the end of each fiscal year, DWM will prepare a report detailing the use of the funds and benefit to watershed protection and long-term reservoir water quality.

8. To aide in administering the grants program DWM will produce "fact sheets" and brochures. Common issues and themes that continuously arise, due to both turnover in local boards and general educational needs. DWM has already developed fairly detailed materials and sample bylaws as described above, but such materials can be supplemented with effective brochures, fact sheets, and other outreach materials. Subjects that can be addressed include:

    - Septic systems
    - Erosion and sedimentation control
    - Agricultural best management practices (BMPs)
    - Stormwater management
    - Hazardous materials
    - Growth management tools and techniques
    - Zoning bylaws and subdivision regulations
    - Natural resource management
    - DWM programs
    - Fiscal impacts of growth

DWM will create, print, and distribute at least two fact sheets per year, responding to the topics of greatest interest or need.

5.4 Public Education

Accomplishments:

- DWM's Interpretive Services staff provides school-based education programs and interpretive programs for adults. Since 1996, more than 600 programs have been delivered to 33,000 participants.
- Quabbin Visitor Center is open to the public 360 days per year providing information on water resources and DWM's watershed protection programs.
- Coordination of Project WET and implementation of Teacher Workshops for Project Learning Tree and WILD, Quabbin History and Water Quality programs.
- Participation in regional and statewide environmental education programs and groups.

Assessment:

- Public education is an essential part of any watershed protection program.
- Education efforts appear to be improving attitudes towards MDC/DWM.

Key Activities:

- Continue/expand school programs; target increased involvement from watershed schools.
- Increase interpretive programs and on-site educational programs.
- Increase environmental education resources for teachers, students and the general public, including the expansion of the DWM's web site to provide watershed information.
- Purchase sign lettering and graphics imaging machine for the Division and implement assist with updating/improving the Section's signage program.

Many natural resources, environmental agencies, and private conservation organizations use educational and interpretive services as a cost-effective way to protect resources and instill a better understanding and appreciation of stewardship of natural resources among visitors. To advance their message and to obtain greater protection of water quality, many water suppliers, particularly regional systems, incorporate interpretive services into their watershed management programs.

This section describes DWM's methods of educating watershed residents and the general public, and their school-based programs that provide general education/awareness of watershed issues. In this Plan Update, educational and outreach efforts are discussed in several sections, based on the focus and intended audience:

- Public access - related outreach - **Section 4.3**.
- Public information and technical assistance to residents relating to the WsPA - **Section 5.1**.
- Technical assistance/coordination with other state and federal agencies - **Section 5.2**.
- Technical assistance to municipalities on planning issues - **Section 5.3**.

Section 5.4 addresses education and outreach aimed at the general public, watershed residents, and schools.

5.4.1 Program to Date

5.4.1.1 History

Throughout its history, DWM has conducted various forms of education and outreach to residents, students, teachers, public officials, legislators, and other water suppliers throughout the watershed system.

The Quabbin Visitor Center was established pursuant to legislative direction in 1985, and has served as a major focal point for information about the watershed system, ranging from engineering and technical data to historical, sociological, and archeological information. The Center is staffed and open to the public 360 days per year. Approximately 30,000 persons visit the Center annually, where they can obtain information on DWM watershed protection programs in addition to public access policies.

Historically, DWM has had formal links to watershed residents and local officials via advisory committees, including the Quabbin Watershed Advisory Committee (QWAC), the Wachusett Advisory Committee (WAC) for the Wachusett and Sudbury watersheds, and the Ware River Watershed Advisory Committee (WRWAC), established by special legislation in 1997. A member of the Interpretive staff sits on the Friends of Quabbin Board, a non-profit organization dedicated to the preservation and protection of the Quabbin Reservoir watershed, and the Swift River Valley Historical Society, the official historical society for the disincorporated Swift River Valley towns.

Additionally, DWM regularly coordinates release of public information through MDC's Office of Public Information. Through the years, DWM also has used signs at its lands and facilities throughout the watershed system to educate the public. The purchase of new sign making equipment will significantly enhance the Division's signage program, improving the quality and effectiveness of information conveyed to the public through this medium.

5.4.1.2 Current Program and Accomplishments

The 1991 Plan did not specifically list education and outreach as a protection measure category, however, related tasks were included in many other protection measures. For example, "provide technical assistance" was listed as a DWM action for on-site septic systems, logging, construction, agriculture, and pesticide and fertilizer use, etc., in most cases aimed at municipalities and other state and federal agencies rather than directly at land owners and residents.

School programs are a proven method of distributing environmental information. Children learn easily and bring such knowledge home to their families. Thus, DWM has made education via the schools a high priority. The Interpretive Services staff has a School Program Watershed Coordinator whose primary responsibility is working with watershed community schools to provide classroom programs, field trips, teacher consultations, workshops and resources to these towns. DWM participates in several environmental education networks, including the Massachusetts Drinking Water Education Partnership, Connecticut River Watershed Education Initiative, Secretaries Advisory Group on Environmental Education (SAGEE), Massachusetts Envirothon, Massachusetts Environmental Education Society (MEES) and the New England Environmental Education Alliance.

The Quabbin Section has sponsored activities for school children and for the general public during Drinking Water Week, traditionally the first full week of May. In an effort to draw attention to our precious drinking water resources and the need to conserve and protect them, the Interpretive staff has developed special programs to increase awareness and appreciation of drinking water. In cooperation with the Massachusetts Drinking Water Education Partnership, performances with the Minneapolis, MN based National Theatre for Children (NTC) have been offered to watershed community schools. Additional educational resources and programs have been offered to supplement the NTC performances. The Section has also hosted a Drinking Water Week Open House, providing a behind-the-scenes view of watershed management operations and resources to members of the general public and watershed community officials.

In addition, since 1991, DWM has sought to increase the extent of formal education and outreach programs. A significant step was the designation of DWM's Director as the Massachusetts Coordinator of Project Water Education for Teachers (WET), a nationally recognized teacher training and curriculum guide for incorporating environmental education into elementary through high school curriculum programs.

Since assuming this role in 1996, DWM organized the Massachusetts Project WET Advisory Committee, which meets annually, and has held four facilitator training programs resulting in the certification of 75 teacher facilitators statewide. Each facilitator is then committed to holding at least two teacher training workshops in the use of the Project WET Curriculum Guide in their local area. To date, Project WET workshops have been offered to over 600 educators, community leaders and state employees. In this role, DWM publishes a semi-annual newsletter, "Splash", which goes to every certified facilitator and teacher trained in the Project WET program.

In addition, DWM added the Watershed Ranger program to the Wachusett Reservoir watershed in November 1994 and to the Quabbin Reservoir/Ware River watersheds in March 1997. The Watershed Rangers conduct and coordinate the Division's public access and patrol activities (as detailed in **Section 4.3**) and provide information to visitors in the field.

The health of the watershed system is, in part, dependent on the behavior of the people who live and work in the watershed. In summary, virtually all of DWM's programs now involve an outreach component. To build general awareness of and interest in the watershed environment, the Interpretive staff have initiated school-based programs, interpretive programs for adults, and exhibit-based and written information at the Quabbin Visitor Center. These efforts are an important step in creating stewardship attitudes in watershed residents and visitors.

5.4.2 Assessment

DWM has been very successful in establishing an active watershed education program in the watershed community schools. An increasing number of educators from watershed school districts have participated in Project WET trainings and other DWM-sponsored workshops. DWM recognizes the need to increase its involvement in Quabbin Reservoir watershed schools through either direct presentation of programs, teacher training efforts, or support other educational efforts within the schools (providing water test kits, GIS maps, Quabbin staff expertise, etc).

There has been a concerted effort to expand interpretive programs for general public. From 1996 to the present, more than 600 educational/interpretive programs have been offered by the Interpretive staff, with an estimated 33,000 participants. This program has been tremendously successful in reaching many people. DWM recognizes that additional audiences need to be reached to increase awareness of watershed issues of mutual concern

5.4.3 Program Approach

5.4.3.1 Goals

The Division has established the following goals for its education and outreach program:

- Foster an attitude of stewardship of the land and water resources of the watershed system among area residents and businesses in recognition of our mutual dependence on these irreplaceable resources; enhance and promote good relations with area citizens.

- Promote understanding of the physical, chemical, and biological properties and functions of water, including surface water, groundwater, wetlands, and aquifers; and promote understanding of the relationship between land use and water quality in a watershed dedicated as a source of public water supply.

- Accomplish widespread awareness/knowledge of and voluntary compliance with the MDC/DWM's Rules and Regulations and the public health significance for which such rules are required.

5.4.3.2 Five-Year Objectives

Within the next five years, DWM objectives for public education and outreach are:

1. Continue the array of educational programs and efforts currently underway, including support of Project WET, SAGEE, the Massachusetts Envirothon and National Drinking Water Week events, and the provision of in-class programs and presentations by watershed staff experts.

2. Increase interpretive programs and on-site educational programs by the Interpretive Services and other watershed staff.

3. Develop Fact Sheets and informational materials on specific watershed management and water supply protection issues.

4. Improve and expand the use of signs in coordination with the implementation of the Public Access Management Plans for the Quabbin Reservoir and Ware River watersheds.

5. Expand resources for educators and the public at the Quabbin Visitor Center to provide scientific, sociological, and historical information.

6. Expand information available on the DWM's website to provide watershed and access information to the public.

7. Develop and disseminate materials related to public access and watershed management through the Visitor Center including maps, trail guides, brochures, books and fact sheets.

8. Continue to work with the Public Information Office to coordinate press releases to the local media.

9. Convert the East Garage building space to an auditorium. This will provide a fully accessible facility for school groups, public presentations and meetings.

5.4.3.3 Activities

1. School Programs
    a. Expand the Quabbin Reservoir watershed curriculum using the various curriculum materials developed by MWRA, DEP, EPA, Project Wild, Project Learning Tree, and Project WET and other appropriate watershed resources.
    b. Continue to support Project WET and teacher training opportunities. Increase participation of watershed school system teachers in Project WET, Water Quality, Quabbin History and Watershed Management Programs by providing training opportunities through in-service workshops and day-long offerings. Conduct follow-up interviews with teachers to determine any needs particular to the Quabbin area.
    c. Continue to offer in-school programs to Quabbin Reservoir and Ware River watersheds school systems.
    d. Continue to offer field trips for schools in the Quabbin Reservoir and Ware River watersheds.
    e. Continue to offer special programming to watershed schools as part of Drinking Water Week activities.
2. Interpretive Services
    a. Continue/expand collaboration with other organizations and watershed communities to reach a more diverse audience. Identify specific groups and their educational needs.
    b. Develop suitable portable exhibits for use in talks and presentations.
    c. Expand self-guided interpretive trails such as the Forest Stewardship, focusing on natural resource management and water quality. Include interpretive signs and information, such as DWM management programs, forest succession, history of the reservoir, wildlife, etc.
    d. Coordinate with visiting groups to provide orientation at the Visitor Center.
3. Visitor Center
    a. Expand resource center materials to provide local teachers, town officials, students of area schools and colleges, and other local organizations with educational information on the watershed system, water quality, history and development of the watershed and water supply system, water pollution, and water supply protection and management. A wide range of journals, literature, and technical manuals, as well as research facilities, will be available.
    b. Continue development of watershed exhibits for display in the Visitor Center, watershed community libraries, and local events.
    c. Offer a speakers' bureau through which outside organizations may request speakers with particular expertise in a variety of environmental, water resource, wildlife, and watershed protection issues.

4. In conjunction with the community technical assistance program, provide input on fact sheets responsive to public interests. The fact sheets will deal with such issues as on-site wastewater disposal, stormwater management, household hazardous waste disposal, MDC regulations for the protection of the water supply, and non-point source controls.

5. Work with other sections of DWM to develop and maintain a site on the World Wide Web. Offer information on access, rules, stewardship and other areas of watershed management interest and links to related web sites.

6. In conjunction with the implementation of the MDC/DWM Public Access Management Plans for the Quabbin Reservoir watershed and Ware River watershed, improve the Quabbin signage program throughout the watershed, including interpretive signs, directional signs, and clear signs indicating access restrictions. Coordinate purchase, installation and training of new sign-making and graphics imaging equipment to improve quality and clarity of signage.

7. Provide graphics support to Division Staff to increase quality and effectiveness of publications, brochures and public documents.

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Section 6
Pathogen Prevention Programs

A major objective of the federal Surface Water Treatment Rule (SWTR) is to provide protection from microbiological contamination and to minimize potential for waterborne disease. Since the rule was promulgated in 1989, water suppliers and regulators across the country have become more cognizant of and focused on microbiological risks. Bacteria, viruses, and protozoa that can be transmitted and may cause illness in humans are collectively termed pathogens.

As described in **Section 3**, minimizing the risk of waterborne disease via pathogens is a top water quality goal for the Watershed Protection Plans. MWRA and MDC/DWM developed and implemented a pathogen control program seeking to minimize risk at each of the three steps in the water supply pathway: source, treatment, and distribution.

DWM and MWRA also use monitoring and disease surveillance in the pathogen control program. Monitoring includes extensive sampling for fecal coliform (the traditional indicator organism) and pathogens (see **Section 2.2**) in the reservoirs and throughout the watersheds. DWM formed an internal pathogen prevention working group comprised of DWM and MWRA staff. The group worked on sampling methods, an approach to watershed sampling (location and frequency), interpretation of data, and prioritization of sources. DWM is currently conducting research into newly evolving analytical methods that can help determine the nature of the source of fecal contamination, as well as better indicators of fecal contamination of significance for transmission of disease to humans (see **Section 8.1**).

Disease surveillance is performed by the Massachusetts Department of Public Health (MDPH) through the Bureau of Communicable Disease Control Surveillance Unit. Local BOHs and the state laboratory are required to report every case of the diseases listed in 105 CMR 3.00. MDPH investigates all possible outbreaks, defined as three or more cases within a small geographical area. As part of its public health research program, MWRA now funds active surveillance by both MDPH and Boston Public Health Commission, and is participating in research by Tufts University on endemic waterborne disease rates, which is sponsored by the National Institute of Health and EPA.

This section of the Quabbin Reservoir Watershed and Ware River Watershed Protection Plan Update focuses on source-related pathogen control measures; information concerning treatment and distribution measures is available in various other MWRA documents.

The most common pathway for pathogen transmission is via the fecal-oral route. Generally, potential sources of waterborne disease include human waste (sewer discharges, recreation) and animal populations (e.g., wildlife, farm animals, and domestic animals). Each species has associated pathogens that it may be more likely to carry (e.g., birds may be more likely to have *Salmonella*, and are unlikely to have *Giardia*), and certain pathogens from some species may not be cross-transmissible to humans. The control approach, however, is the same: to minimize (and eliminate where possible) potential for deposition of wastes in the watershed or on-reservoir surface.

Waterborne transmission of pathogens to the water supply intake requires three events to occur:

1. Humans/animals that are infected deposit wastes containing viable waterborne disease agents.
2. The agents reach the source directly or are carried via stormwater.
3. The agents survive in the source to the point of intake.

DWM's pathogen control programs are designed to break all three steps in the chain, through the following: 1) source controls to reduce the potential for the initial deposition of waste; 2) buffers and land use planning controls to reduce the possibility of pathogens reaching the tributaries or reservoirs; and 3) implementation of innovative treatment technologies to lessen the likelihood of pathogens reaching the intake as a viable organism.

The reservoir's morphological characteristics (area and depth) permit settling of particulate matter which minimizes pathogen survival. The goal of pathogen minimization also benefits from reservoir morphological characteristics. While the precise effect of detention times on all the different pathogens has not been studied, residence time has been shown to significantly reduce fecal coliform bacteria levels, and the combination of settling and die-off may reduce survival or concentrations of other pathogens as well.

DWM's pathogen control programs are presented in this section, including Wildlife (**Section 6.1**), Agriculture (**Section 6.2**), Wastewater Disposal (**Section 6.3**), and Stormwater BMPs (**Section 6.4**). The Division's control of watershed lands through ownership and regulation also significantly prevent pathogen transmission by providing buffer zones and restricting inappropriate activity in sensitive areas; these efforts were described in **Sections 4 and 5.**

6.1 Wildlife

Accomplishments:

- DWM implemented the Bird Harassment Program, now viewed as a model for others, which dramatically reduced the fecal coliform counts at the CVA intake.
- DWM defined an Aquatic Wildlife Pathogen Control Zone, in which animals of concern (beaver and muskrat) are surveyed and removed.
- Habitat modifications were also implemented to reduce nesting and visiting geese and to discourage beaver habitation.

Assessment:

- The impact of birds on the intake water quality has been significantly diminished due to the harassment program and related efforts. Aquatic mammals are a potential concern, but are being controlled in the critical area, and there is no evidence of pathogen contamination from these animals reaching the intake.

Key Activities:

- Continue successful Bird Harassment Program, including ongoing research to use all available and appropriate methods.
- Implement additional habitat modifications where appropriate.
- Continue beaver and muskrat controls in the Aquatic Wildlife Pathogen Control Zone, and evaluate their effectiveness annually.

In recent years, wildlife have become a concern among water supply professionals due to a new awareness of wild animals' potential to transmit pathogens combined with the fact that many wildlife species inhabit natural, forested areas that typify drinking water source watersheds.

Indeed, Quabbin Reservoir provides first-hand evidence of the impact of roosting gulls on fecal coliform levels, and the ability to successfully control them to the point that gull and fecal coliform levels are now extremely low.

The Quabbin Reservoir watershed is inhabited by a variety of wildlife species typical of New England forests, wetlands, and fields. The majority of these animals pose no risk to water quality. Certain species, however, are a concern because they are known to be possible carriers of certain pathogens and live in or near the water; and thus, have the potential to introduce contaminants to water supplies. The following species have been identified as posing a possible threat to water quality in Quabbin Reservoir:

- Birds roosting on the reservoir or residing on reservoir islands or shoreline, since their droppings contain bacteria in the fecal coliform group and may carry *Salmonella* and *Cryptosporidium*. Such birds include:
    - Herring, Ring-billed, and Great Black-Back Gulls
    - Canada geese and other waterfowl
- Aquatic Mammals residing in the reservoir or in direct tributary streams or wetlands may carry *Giardia* or *Cryptosporidium*. Such mammals include:
    - Beaver
    - Muskrat

6.1.1 Program to Date

6.1.1.1 History

Prior to 1991, the MDC had a limited role in monitoring or controlling wildlife activities. The MDC/DWM wildlife biologist conducted yearly surveys at Quabbin Reservoir watershed for specific species (e.g., geese, beaver, and coyotes). General observations of species easily seen were noted, but no regular monitoring or control activities were conducted.

6.1.1.2 Current Program and Accomplishments

1991 Plan

The 1991 Plan identified one watershed control measure to address animal populations[1]: to evaluate and implement alternatives for eliminating water quality impacts of gull/geese roosting at the reservoir. This action has been successfully implemented.

Bird Harassment Program

Quabbin Reservoir is a seasonally attractive nighttime roost site for a variety of birds. Herring and great black-backed gulls, Canada geese, and ducks will utilize the reservoir from early fall until the reservoir freezes (or until spring, if it doesn't freeze over) as a nighttime roost and daytime loafing area. Typically, birds are attracted to the western portion of the reservoir (i.e., west arm); the Chicopee Valley Aqueduct (CVA) is located at the southern end of this area. Prior to 1992, large numbers of birds (~2000), primarily gulls, would regularly roost in this western area.

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[1] In the animal populations section, the Plan also recommended "Evaluate impact of increased bacteria levels further down the system." MWRA has conducted extensive studies of system water quality, and has a major research effort underway.

Beginning in 1991, the Division began to study the relationship between the large numbers of roosting gulls and elevated fecal coliform counts at the CVA intake. A strong correlation was noted between birds near the CVA and elevated fecal coliform. In response to this study, the Division initiated a bird harassment program in the fall of 1992.

The MDC/DWM's Bird Harassment Program is a dynamic program that is continually evolving. In 1992, the program consisted of a single boat with 2 people and a supervising shore person. The "gull harassment zone" (see **Figure 6-1**) extended out 2 miles from the CVA intake and encompassed the southern basin near the intake and the west arm of the reservoir up to the island opposite Gate 8. Driving birds out of this area (either off the reservoir or to an alternative roost approximately 4.5 miles north of the intake) resulted in consistently low fecal coliform levels. As the program evolved each year, the harassment zone was extended further north. Although water quality data indicates that the initial harassment zone is adequate to ensure fecal coliform compliance, the Division feels a more conservative approach is to drive birds as far away as harassment techniques allow. Early in the program, the Division addressed implementation needs, including designating and training staff and determining the times when harassment efforts were needed. The Division also gathered data about how and when the gulls arrived at the reservoir.

The Bird Harassment Program relies primarily on a human presence in boats and on shore and the use of pyrotechnics (e.g., 12-gauge and .22 shell crackers and screamers). Since 1992, the program has evolved to include up to 3 boats. In addition, the program includes comprehensive bird counts and the use of lethal methods to reinforce non-lethal tactics. Further, the Division formed a Bird Harassment Technical Advisory Committee that includes the state ornithologist, USDA-Animal Services personnel, and others. The Committee was helpful in identifying new possibilities and harassment techniques and monitoring the success of the program as it evolved. The Committee continues to be involved in program development and review. The Division maintains daily logs of activity and prepares regular reports of the program documenting its effectiveness.

As a result of these efforts, the Division's Bird Harassment Program has been extremely effective and has directly reduced coliform levels at the intake. Since 1991, the CVA intake's fecal coliform levels have been in compliance with the SWTR criteria for a filtration waiver.

Gull Habitat and Food Source Modifications

DWM also targeted statewide landfills, which are key sources of food for gull populations. Working with landfill owners and DEP, DWM first focussed on landfills near, but outside of the Quabbin Reservoir watershed. These landfills represented a convenient food source and probably attracted gulls to the region. DWM staff provided technical assistance to operators of several key landfills near Quabbin Reservoir. In addition, DWM staff actively harassed gulls at select landfills for a period of time and noticed a resultant decrease in the number of birds roosting at the reservoir. Next, DWM worked cooperatively with DEP to require bird controls at open landfills throughout the state, since gulls may travel 50 miles from their food source to a roosting site. DEP adopted a policy in 1998 to require landfills to take active measures to limit the number of gulls feeding at their site. DWM staff now occasionally monitors landfill activity and provides technical advice and assistance to landfill operators when requested.

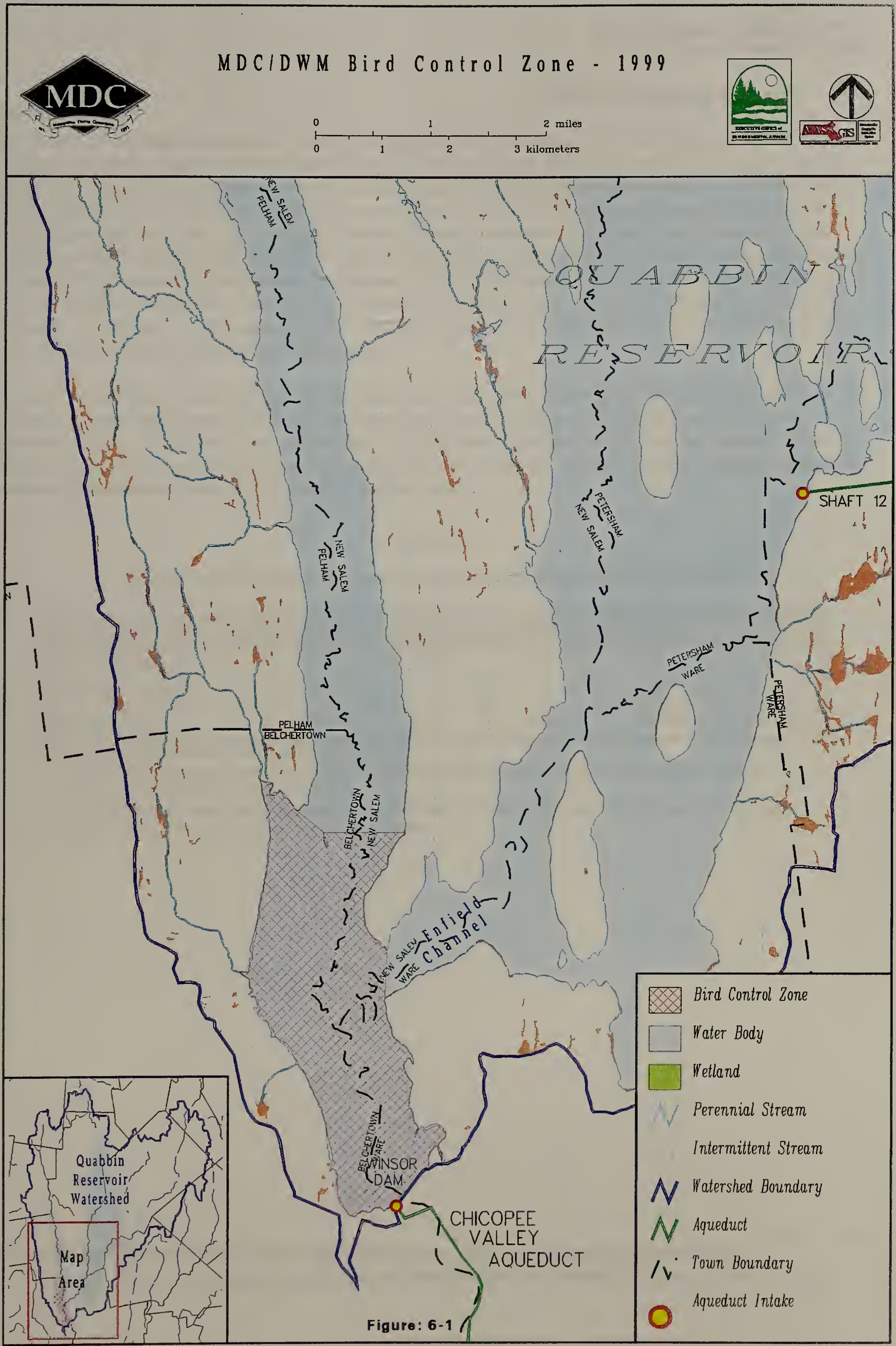
MDC/DWM Bird Control Zone - 1999
MDC
0 1 2 miles
0 1 2 3 kilometers
QUABBIN RESERVOIR
NEW SALEM
PELHAM
PETERSHAM
WARE
BELCHERTOWN
SHAFT 12
Enfield Channel
WINSOR DAM
CHICOPEE VALLEY AQUEDUCT
Quabbin Reservoir Watershed
Map Area
Bird Control Zone
Water Body
Wetland
Perennial Stream
Intermittent Stream
Watershed Boundary
Aqueduct
Town Boundary
Aqueduct Intake

Figure: 6-1

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Goose Controls

In addition to the daily harassment program to reduce nighttime roosting, DWM also focuses on reducing the daytime presence of geese within the Bird Control Zone. In general, there are very few gulls present at the reservoir during the day. However, there is a resident population of geese at the reservoir which can swell during migration. In order to address the presence of these birds at critical areas, measures were taken to discourage their presence. A 3-foot-high fence was erected between the water and grassy areas along the shore around the DWM Administration building in Belchertown. In addition, rose bushes were planted along the shoreline to act as a barrier to geese moving to and from the water. This is particularly important during the few weeks each summer when geese are unable to fly; they will not use an area without direct shoreline access to a water body. These measures were reinforced with active harassment during critical times of the year to re-direct geese away from the intake area.

In 1996, DWM began to control resident Canada goose populations (**Table 6-1**). Each spring, an effort is made to locate nesting geese within the bird harassment zone. Eggs in each located nest are treated to prevent hatching. This effort is aimed at reducing the resident population of geese on the reservoir. Prior to 1996, many young geese could be seen on the reservoir each summer. Population control activities have reduced the number of young goslings surviving each year.

Table 6-1

Canada Geese Population Control Efforts at Quabbin Reservoir 1995-1999

	1995	*1996*	*1997*	*1998*	*1999*
No. of nests found	N/A	4	0	10	8
No. of eggs treated	N/A	13	0	43[1]	37[2]
No. of goslings	Unknown	6	Unknown	Unknown	Unknown

Source: (MDC/DWM Natural Resources, 2000)

[1] The USFWS depredation permit issued to MDC/DWM for 1998 required leaving one viable egg in each nest, whereas in previous years all eggs were addled.

[2] The USFWS depredation permit issued to MDC/DWM for 1999 required leaving one viable egg in half the nests located. In the rest of the nests, all eggs could be treated.

Additional Measures – Aquatic Wildlife Pathogen Control Zone

Though it was not identified in the 1991 Plan, control of aquatic mammals (i.e., beaver, muskrat) has become a critical component of DWM's waterborne disease prevention approach because they reside in and around water and can be carriers of *Giardia*, *Cryptosporidium*, and fecal coliform.

The DWM has been monitoring beaver populations on the Prescott Peninsula for the past 30 years. While this area is outside the control zone, it does provide long-term data of an unharvested beaver population. In addition, beaver surveys have been conducted in the Quabbin Reservoir area since the early 1990's. Surveys are conducted to identify active beaver colonies.

Beaver and muskrat control in the Quabbin Reservoir watershed is still primarily in the initial assessment and implementation phase, which may include removal of animals and habitat modification. However, beaver colonies located in the reservoir near the intake structure are removed using licensed trappers and MDC/DWM personnel. Although beaver control activities have been conducted near the Intake for a number of years, virtually no work has been done yet to identify muskrat or other beaver populations within the control zone. DWM identified the Aquatic Wildlife Pathogen Control Zone (**Figure 6-2**), with a target of keeping this area free of beaver and muskrat. A more detailed description of the zone and management activities can be found in the document, *Quabbin and Wachusett Reservoir Watersheds Aquatic Wildlife Pathogen Control Zones, 1999.*

In addition, DWM evaluates the possibility of habitat modification for the high priority areas (e.g., removal of preferred vegetation). Habitat modification will be implemented at several high quality aquatic mammal sites along the shoreline; DWM will monitor these sites to assess the effectiveness of this approach to discourage future colonization.

6.1.2 Assessment

Resident reservoir goose populations appear to be stable or slightly decreasing while statewide resident goose numbers continue to increase. The daily fluctuation of gull numbers during the harassment season remains unpredictable. Survey data does suggest that herring gull populations are experiencing a regional decline while ring-billed and great black-backed gull numbers are increasing. During the late spring and summer, most gulls, geese, and other waterfowl have left the reservoir to nest and breed in other locations. There is still an annual increase in gull and goose numbers during the fall and winter, however the daily average number of birds has declined greatly in the past 10-15 years.

By making bird control its top priority in the early 1990s, DWM dramatically reduced resident, daytime, and roosting gulls and geese. Consequently, coliform levels at the intake have dramatically decreased, as demonstrated in **Figure 2-7**. Having extensively researched bird control and experimented with various methods and equipment, DWM now has a proven, state-of-the-art bird control program.

Aquatic Wildlife Pathogen Control Zone - 1999

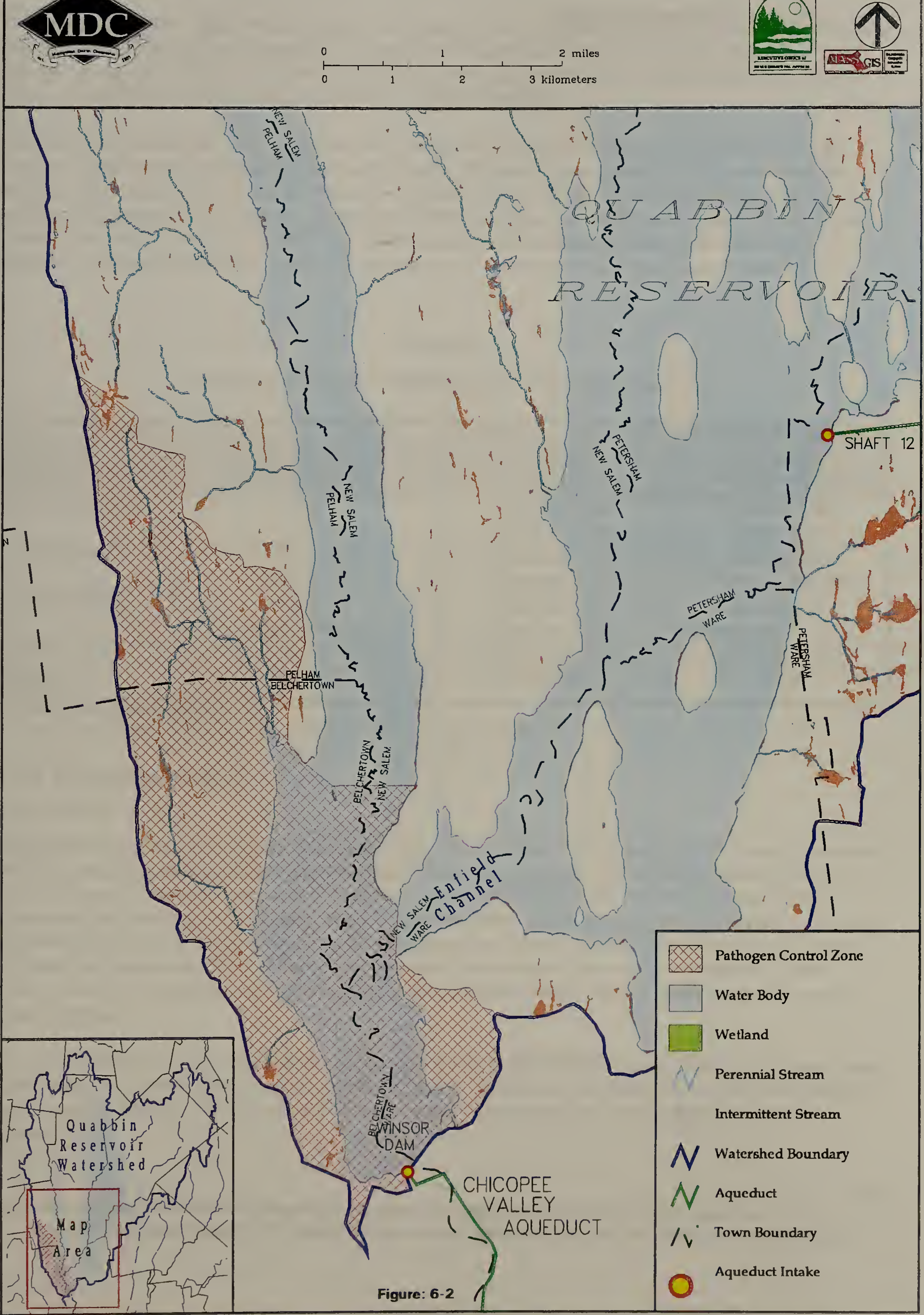
MDC
0 1 2 miles
0 1 2 3 kilometers
QUABBIN
RESERVOIR
NEW SALEM
PELHAM
PETERSHAM
NEW SALEM
SHAFT 12
PETERSHAM
WARE
PELHAM
BELCHERTOWN
BELCHERTOWN
NEW SALEM
Enfield Channel
NEW SALEM
WARE
BELCHERTOWN
WARE
WINSOR DAM
CHICOPEE VALLEY AQUEDUCT
Quabbin Reservoir Watershed
Map Area
▨ Pathogen Control Zone
Water Body
🟩 Wetland
Perennial Stream
Intermittent Stream
Watershed Boundary
Aqueduct
Town Boundary
● Aqueduct Intake

Figure: 6-2

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The aquatic mammal control program is in a preliminary phase. However, local and statewide populations of both muskrat and beaver are increasing. As populations expand, animals may try to use habitat that is currently unoccupied. DWM's efforts are focused on removing animals in the defined Pathogen Control Zone and modifying habitat in this area to reduce future colonization.

The occurrence and density of wildlife species in the watershed, or on the reservoir, is dynamic, and the number of individuals can fluctuate seasonally or daily. **Table 6-2** summarizes DWM's estimate of the maximum prevalence of each species within the respective control zone. These numbers represent the maximum witnessed, not the average. At present, DWM's programs are effective in controlling the focus species' presence in each control zone. The table also shows the prevalence (defined as the maximum observed number of individuals) within the control zone of these species under the control program.

Table 6-2

Prevalence of Selected Wildlife Species at Quabbin Reservoir

Species	*Historical Prevalence* [1] *(maximum number)*	*Current Level Of Control*	*Current Prevalence with control (maximum number)*
Gulls (all species)	2000	Roosting: HIGH Daytime: LOW	Roosting: <100 Daytime: <10
Canada geese	100 (resident) 1000 migration	Resident: MEDIUM Migration: HIGH	Resident: 100 Migration: 100-200
Other Waterfowl	30 (resident) 300 (migration)	Resident: LOW Migration: HIGH	Resident: 30 Migration:100
Beaver	Control Zone: LOW	Control Zone: HIGH	Control Zone: 2-6
Muskrat	MEDIUM	MEDIUM	15-30

Source: (MDC/DWM NR, 2000)

[1] Historical prevalence is the maximum number observed in the past 10 years.

6.1.3 Control Approach

6.1.3.1 Goals

DWM has two goals concerning wildlife populations. The first goal is to minimize or eliminate the presence of gulls, geese, and other waterfowl from the Bird Control Zone (**Figure 6-1**) to control pathogen levels at the CVA Intake. Based on water quality sampling, an attempt to exclude all birds from the reservoir is impractical and probably not necessary. Very low bird densities within the Zone should provide a high level of protection to the communities receiving Quabbin Reservoir's water. DWM's role is to actively develop, construct, and implement new techniques and devices to harass and exclude the above-mentioned bird species from the protected area, in addition to continuing the successful, ongoing bird harassment program already in place.

The second goal is to eliminate muskrat and beaver from the MDC/DWM Aquatic Wildlife Pathogen Control Zone (**Figure 6-2**) to provide conservative protection from pathogens that can be carried and transmitted by these animals. Further, DWM's role is to identify, monitor, and control muskrat and beaver within the defined zone.

6.1.3.2 Five-Year Objectives

For the next five years, DWM objectives for wildlife are:

Bird Harassment Program and other Bird Controls

1. Continue to control the occurrence of gulls, geese, and other waterfowl within the Bird Control Zone.
2. Continue to reduce the resident Canada goose population.
3. Monitor nesting activities of all gull species on the reservoir and eliminate any attempt to establish a nesting colony.
4. Explore and develop new harassment alternatives and innovative strategies to ensure long-term control of bird species.
5. Work with DEP to ensure bird control requirements are enacted at statewide landfills.
6. Assess current land management practices' (e.g., mowing or maintenance of lawn areas) impact on problem wildlife species and recommend new practices that discourage wildlife from critical areas of the reservoir.

Aquatic Wildlife Program

1. Identify and remove muskrat and beaver from within the MDC/DWM Aquatic Wildlife Pathogen Control Zone and maintain the zone free from these species.
2. Continue to study the prevalence of pathogens in wild species and try to develop methods that enable identification of pathogens as either human or non-human origin.

6.1.3.3 Activities

MDC/DWM will meet these objectives through several programs:

1. Bird Harassment Program
    a. Continue year-round effort of active harassment and monitoring using human presence, boats, pyrotechnics, passive scare devices, and newly developed techniques.

   b. Continue to identify and test new harassment techniques. Research, design, develop, construct, and deploy new harassment techniques that can be used in conjunction with the on-going bird harassment program. Focus on new techniques designed to provide continual harassment without human presence, and techniques that provide versatility and adaptability to prevent acclimation by problem bird species.

   c. Work with DEP to ensure bird control requirements are enacted at regional landfills. Obtain available landfill inspections and regional bird population data. Provide technical assistance on harassment methods to landfill operators as requested by DEP.

2. Bird Population Control

   a. Conduct annual effort to identify nesting Canadian geese and gulls on the reservoir and treat laid eggs to prevent hatching.

   b. Monitor results.

3. Aquatic Wildlife Control Program

   a. Establish "Control Zone" concept and a continuing permit through agreement with DFW, DEP, and other agencies.

   b. Conduct year-round effort to identify populations of beaver and muskrat within the defined protection zone.

   c. Control beaver and muskrat populations within the Aquatic Wildlife Pathogen Control Zone using trapping and shooting.

   d. Implement habitat manipulation to control and discourage populations within the protected zone.

4. Continue ongoing research with the University of Massachusetts, Amherst to develop methods to differentiate pathogens as human or animal source (see **Section 8.1**).

6.2 Agriculture

Accomplishments:

- DWM has worked with local farmers since development of the 1991 Plan, to correct problems related to agricultural runoff. Numerous site visits have been conducted as a result of water quality data, sanitary survey or complaints from local residents or officials. There are very few agricultural operations in the Quabbin Reservoir watershed and Ware River watershed.
- DWM has established good working relationships with USDA Natural Resources Conservation Service (NRCS) and many local farmers.
- Staff conducted a joint meeting with NYC DEP officials to discuss agricultural best management practices currently implemented that can be applied to MDC/DWM watersheds.
- DWM recently completed an intensive inventory of all agricultural sites in the MDC/DWM watersheds, and developed an inventory of potentially applicable agricultural BMPs for these sites.
- The WsPA prohibits use of fertilizers, herbicides, and pesticides, storage of uncovered manure, and change of runoff characteristics (overgrazing) in sensitive watershed areas.
- MDC/DWM continues to monitor the increasing number of horses in the Ware River watershed and horse access on Division lands due to increasing numbers of residentially owned stables.
- Staff conducted special water sampling program to evaluate the impact that animal grazing and watering has on fecal coliform levels in a receiving brook and corrected the problem with a structural agricultural BMP.

Assessment:

- There are sites in the Quabbin Reservoir and Ware River watersheds with some livestock. The majority of these sites are very small scale.
- The greatest concern posed by agricultural activities is the threat of contamination from animal wastes, possibly containing pathogens. Assessment of actual risk is very complicated. Overall, agriculture that is properly conducted should pose a very limited risk to water supply.

Key Activities:

- Address any problems from smaller farms through sanitary surveys and follow-up.
- Implement best management approaches developed in the Wachusett Reservoir watershed, including education and outreach, for small-scale agricultural sites.
- Work with Massachusetts Department of Food and Agriculture (DFA) and other appropriate agencies to develop an Agricultural Advisory Group.

6.2.1 Program to Date

6.2.1.1 History

From the period of its initial development as a drinking water supply through the 1930s, agriculture was an important land use in the Quabbin Reservoir and Ware River watersheds. Since the end of World War II, the number of active farms in the watersheds has declined, similar to trends seen in other areas of the Commonwealth.

Traditionally, MDC/DWM water quality concerns regarding agriculture were related to livestock. This is reflected in MDC's regulations:

- 350 CMR 11.09 states that "No person shall...construct, establish or maintain any agricultural facility or place where animal manure may be deposited or accumulated without adequate provision to prevent any manure or other pollutant from flowing or being washed into the Waters of the Watershed System".

- 350 CMR 11.04 prohibits the outdoor storage of fertilizers, herbicides, pesticides, and manure within certain areas of the watershed.

MDC/DWM inventoried animals through sanitary surveys and working with local town boards, primarily the Boards of Health.

6.2.1.2 Current Program and Accomplishments

1991 Plan

The 1991 Plan considered potential water quality threats from agricultural practices under three categories: 1) Herbicides/Pesticides/Fertilizers, 2) Animal Grazing/Agricultural Runoff, and 3) Barnyards/Feedlots. These three categories were assessed as Low to Moderate Potential Threats to water quality. The Plan proposed a cooperative approach, working with other State and Federal agencies, including Massachusetts DFA and the USDA NRCS.

The 1991 Plan placed a greater emphasis on actions dealing with herbicides, pesticides, and fertilizers than on the other two categories. To prevent water quality problems resulting from herbicides, pesticides, and fertilizers, the Plan called for DWM to work with DFA on pending regulations to protect groundwater water supplies; to review commercial applications of pesticides, herbicides, and fertilizers; to review utility and railroad Vegetative Management Plans (VMPs) and resulting Yearly Operating Plans (YOPs) for vegetative management; and to encourage use of Integrated Pest Management (IPM). The same implementation measures were proposed to prevent problems from Animal Grazing/Agricultural Runoff and Barnyards/Feedlots. The 1991 Plan called for development of an agricultural BMP policy for local agricultural operations and enforcement of existing MDC regulations to prevent pollution from agricultural wastes. (Note: Chemical use on utility and railroad rights-of-way is discussed in **Section 7.1.**)

Status

Since the 1991 Plan was written, DWM has dedicated significant resources to working with farmers and Federal and State agricultural agencies to correct water quality problems related to agricultural practices. All measures called for in the 1991 Plan, and some additional ones, have been successfully implemented.

For several reasons, DWM determined that agriculture particularly applications involving livestock needed to be considered a higher priority than originally considered in the Plan. First, DWM water quality sampling and sanitary survey inspections show that some agricultural operations impact tributary water quality, as measured by

Buffer Zones

Buffer zones can help prevent pollution from agricultural uses directly adjacent to streams and wetlands. Fenced buffers prevent direct water contact by animals. Vegetated buffers zones provide: 1) slowing and adding travel time from sources to waterways; 2) plant uptake of nutrients; and 3) an area for infiltration – reducing viable pathogens in runoff.

traditional water quality indicators, including fecal coliform bacteria, nutrients, and solids. Second, there is increasing concern about pathogens such as *Cryptosporidium* in water supply watersheds, and farm animals may carry and transmit these pathogens. In addition, stormwater modeling in the Wachusett Reservoir watershed shows that pollutant loading from agricultural lands are elevated compared to other land uses in the watershed. At the same time, DWM acquired more information about the number, location, and type of agriculture sites in the watershed, indicating that the watershed has very few sites of the type of greatest concern.

For the purposes of the updated Plan, issues and control activities for agriculture will be discussed under two subject areas: 1) Livestock and Crops, and 2) Chemicals (Pesticides, Herbicides, and Fertilizers).

Livestock and Crops

Significance: Agriculture currently comprises a small portion of the watershed land use currently. MassGIS land use data show that agriculture makes up 3% of the total Quabbin Reservoir watershed land use, 5% of the total Ware River watershed land use, and 8% of the total Wachusett Reservoir watershed land use. Agriculture comprises 5% of the total land use of the combined Quabbin, Ware River, and Wachusett watersheds. These land use figures overstate the extent of agriculture, because many of the areas defined as agriculture on the land use GIS coverage (based on photo-interpretation) are not being actively farmed.

To better understand the agriculture activity in the watersheds, DWM undertook an agricultural Best Management Practices (BMP) Study (discussed below). One component of the study used DWM, town, DFA, and USDA records; Geographic Information System (GIS) land use cover; parcel and land owner database; and field inspections to create a database of all livestock and cropland in the three watersheds in 1997. In the Quabbin Reservoir watershed and the Ware River watershed, the general agricultural trend during this time is a noticeable reduction of larger farm operations. The existing agricultural operations tend to be non-commercial farms (a.k.a., “hobby farms”).

The initial list of agricultural parcels by the land use or property data was reviewed. Multiple parcels for a single ownership were combined, which reduced the number of sites. The next step is ongoing and involves field-checking the land classifications. To date this process has shown that a significant number of parcels which are classified as being in agricultural use are actually inactive or in some other use. **Table 6-3** summarizes the results of this work to date.

Table 6-3

Results of Agricultural Survey Sites in Quabbin Reservoir and Ware River Watersheds[1]

Characteristic	*Number of Parcels Quabbin Reservoir Watershed*	*Number of Parcels Ware River Watershed*
Agriculture	69	123
Animal Husbandry	34	15
Pasture	29	23
Orchard	12	10
Field Crops	34	109
Nursery	2	5
Truck Crops	18	14
Subtotal – Agricultural/ Potential Agricultural Sites	**198**	**299**
Residential	30	54
Open Space	33	35
Non-Productive Agriculture [2]	20	24
Subtotal – Non-Agricultural Sites	**83**	**113**
TOTAL SURVEY SITES:	**281**	**412**

Source: (CEI, 1997)

[1] Initial list and windshield survey conducted 1997; field-verification and database refinements are ongoing.

[2] Fields are overgrown with brush and or fencing is in disrepair

The database also includes information about types and numbers of animals on these sites. These numbers were collected from DFA's database. A quality assurance check by MDC/DWM staff revealed that these figures are extremely inaccurate due to under-reporting by town inspectors (according to DFA staff). Therefore, MDC/DWM has chosen not to report these numbers.

It is important to note that agricultural use is dynamic and the data, especially the animal census, should be considered a "snapshot" of activities in the watershed at the time of the survey (Spring, 1997). However, this survey does show that the majority of operations are small-scale. Few operations have more than 100 animals, and many could be considered "hobby farms".

Policy Approach: Since the 1991 Plan, DWM developed and implemented a policy for working with land owners to correct water quality problems caused by agricultural operations. DWM staff have visited and inspected the most significant farms in the watersheds. The policy is summarized below:

- DWM staff are alerted to a potential problem via a complaint, as a follow-up to water quality sampling results, or as part of routine sanitary survey. An appointment to visit the site is made with the landowner.

- DWM staff visit the site to investigate potential causes of the observed problem, and explain DWM concerns to the landowner. Staff evaluates conditions as they relate to MDC regulations to determine if there is a violation of the regulations.

- If a violation of MDC regulations is noted, DWM staff explains to the landowner that a Notice of Violation will be issued by DWM through DEP.

- DWM staff contacts NRCS, and arrange to make a follow-up, cooperative visit by DWM and NRCS staff. Corrective actions, including agricultural BMPs are suggested. Where possible, NRCS informs the landowner of available funding sources for the corrective measures.

Table 6-4 below presents an example of water quality data collected as part of an investigation of impacts from an agricultural site in the watershed. In this example, the results from water quality testing downstream of the cattle pasture proved a valuable tool used in discussions with the landowner on how best to manage cattle watering and grazing adjacent to a small headwater stream of the Middle Branch of the Swift River. The landowner has since installed fencing to keep cattle from watering inside of the stream; has added fill to prevent runoff from continuing to transport manure through rivulets scoured into the pasture; and has provided an alternative water supply source for watering of the cattle.

Table 6-4

Results of Water Quality Testing Brown's Hill Tributary (1996)

Quabbin Reservoir Watershed

	Fecal Coliform Colonies per 100mL (Membrane Filtration Method)						
Sample Site	9/23/96	10/10/96	10/16/96	10/24/96	11/13/96	11/20/96	11/26/96
Brown's Hill Tributary at edge of cow pasture	--[1]	TNTC[2]	6,700	21,000	300	2,400	24,000
Brown's Hill Tributary at MDC/DWM property line	--	TNTC	400	5,800	1,000	510	17,300
Middle Branch Swift River (213)	2,500	580	10	50	20	10	1,000

Source: (MDC/DWM Quabbin Laboratory, 1996)
[1] -- = No data collected
[2] TNTC = Too numerous to count

The Wachusett Area Water Quality Protection Project: The MDC/DWM has worked with three agencies who are key to establishing working relationships with farmers in the watershed: NRCS, the USDA Agricultural Stabilization and Conservation Service (ASCS) and the University of Massachusetts Cooperative Extension Service. These agencies applied for and were awarded USDA funding for a six-year Wachusett Watershed Protection Project. MDC/DWM provided additional funding for some portions of the project. DWM will apply the lessons learned and agricultural BMPs developed for the Wachusett Reservoir watershed to activities in both the Ware River watershed as well as, where applicable, in the Quabbin Reservoir watershed.

Agricultural BMPs include Nutrient Management Plans, Integrated Pest Management Plans, and manure management. Nutrient Management Plans (NMPs) were developed for dairy farms, which identified how to improve manure utilization. The NMPs help protect water quality and save farmers money by reducing fertilizer needs. Integrated Pest Management (IPM) plans were developed for vegetable farms and orchards. The IPM Plans helped reduce the number of pesticide applications, reducing the total pounds of pesticides per acre. NRCS also worked with several horse farms to prevent manure runoff from getting into watershed streams. Manure storage facilities were constructed, and protective buffer strips were established and fenced off.

MDC/DWM Purchase of Agriculture Land: In some cases, to deal with a severe impact, MDC/DWM has acquired farmland through a "taking" or via a Conservation Restriction (CR). CRs may allow some limited, carefully controlled farm activities on the parcel, usually with conditions or an expiration date. Since the 1991 Plan was written, several agriculture sites have been acquired in fee or as CRs.

Agricultural BMP Study: To better quantify the actual extent of agriculture in the watershed and to develop a better overall approach to identify and correct water quality problems related to agricultural practices, MDC/DWM hired a consultant to develop the *Agricultural Best Management Practices Evaluation for the Quabbin, Ware, and Wachusett Watersheds* (CEI, 1997).

As discussed above, the first part of the study involved a record search and field survey to inventory agricultural sites in the watersheds. Following this, DWM and the consultant compiled an inventory of both structural and non-structural agricultural BMPs being used throughout the country. Each agricultural BMP was reviewed for efficiency in removing pollutants, focusing on strategies to control pathogens. Recommended agricultural BMPs included enhanced buffer zones, livestock health improvements geared to controlling *Cryptosporidium*, education, relocation of feeding areas, and wetlands treatment. A review of existing literature was conducted to determine setback requirements for livestock (buffers). Information on potential funding sources for BMP implementation was also collected.

The technical recommendations are most applicable to the larger agriculture sites, of which there are a small number in the Quabbin Reservoir and Ware River watersheds. Many of the agricultural sites included in the inventory are small, including homeowners with one or two horses, or "hobby farms". These sites will likely need a different approach, since the number of animals or amount of crop is very small and the available land for any BMP is usually limited.

Identification of Critical Agriculture Operations – Manure Storage

As a result of the WsPA, a new covered manure storage building was constructed in Hubbardston, MA, in 1996. This design, developed with assistance from the USDA's Natural Resources Conservation Service, will serve as a model for the many small horse farms in both watersheds.

At the time of publication, DWM's staff is involved in two enforcement cases related to the Watershed Protection regulations. One case involves overgrazing which has changed the surface water runoff characteristics within 200 feet of a tributary to the water supply. The other enforcement case involves an uncovered manure pile within 400 feet of a tributary to the water supply.

Pesticide, Herbicide, and Fertilizer Usage

The 1991 Plan called for a number of actions that would prohibit the use of chemicals on sensitive lands, and minimize and monitor usage of these substance in the watershed. Since the Plan was written, significant progress has been achieved relating to use of chemicals on rights-of-way. Pesticide and herbicide use on rights-of-way is now addressed under Highways, Railways, and Utility Rights-of-Way (**Section 7.1**), while agricultural use of chemicals remains in this section. Chemical use at farms is generally related to crops and orchards. Based on the 1997 agricultural inventory, the most common crop grown in the Quabbin Reservoir and Ware River watersheds is hay, which generally involves less chemical applications than other crop types. Factoring in the water quality goals, chemical use at agricultural sites is a relatively low priority concern.

6.2.2 Assessment

The greatest threat to water supply posed by agricultural activities is contamination from animal wastes, possibly containing pathogens. Assessment of actual risk is very complicated, due to the many unknown factors related to transport, fate, viability, infectivity, dosage; problems with existing testing methods; and other factors which must be considered to evaluate actual risk posed by livestock. Other pollutants, including nutrients, pesticides, and suspended sediments, may be generated by both livestock and crop production. These compounds all pose a potential threat to water quality, but are considered a lesser health risk than pathogens.

Overall, agriculture that is properly conducted should pose a very limited risk to water supply. Across the state, a challenge facing water supplies is how to attain operations and facilities improvements (such as buffer zones; see box on p. 6-17) at farms where needed. With its funding and staff resources, DWM is in a good position to make such improvements, and has in fact accomplished them at selected sites.

6.2.3 Control Approach

6.2.3.1 Goals

Many watershed residents consider farming to be a resource that is an important component of community character, as well as a help in preserving open space. As much as it is a cherished part of the landscape, farming can have negative impacts on water quality. DWM's goal is not to eliminate agriculture, but to minimize the potential for agricultural wastes and chemicals to leave the source and to enter tributary waters of the reservoir, focusing first on pathogens. DWM will work cooperatively with landowners and appropriate State and Federal agencies to develop cooperative solutions to agricultural-related water quality problems. However, DWM will take advantage of any opportunity to acquire farms in sensitive areas as farmers retire or land changes hands.

6.2.3.2 Five-Year Objectives

Over the next five years the DWM objectives for agriculture are to:

1. Refine and implement a comprehensive, inter-agency program to assess and remediate water quality threats from agricultural land use.

2. Develop an approach for assessing and remediating water quality problems from small-sized animal operations not traditionally considered as "farms" (e.g., backyard horse paddocks).

3. Implement the *MDC/DWM Public Access Management Plan Update – Ware River Watershed* (200) in which DWM will monitor, evaluate, and modify accordingly, designated trail horseback riding access allowed on MDC/DWM lands in the Ware River watershed.

6.2.3.3 Activities

In order to achieve the five-year objectives, the following activities will be undertaken:

1. Encourage agricultural BMPs and monitor impacts of small sites.
   a. DWM will address agricultural operations as part of the sanitary survey process.
   b. DWM will research and develop agricultural BMPs and BMP implementation approaches for small-scale, hobby type operations in the watersheds.
   c. In conjunction with public education and technical assistance programs, DWM will prepare and distribute literature concerning agricultural BMPs for hobby farms and funding/grant sources.
2. Coordinate with DFA and DEP on watershed agriculture issues.
   a. DWM will participate with DFA on an Agricultural Advisory Group. As one item, this group could work with DEP concerning the agency's ability to use existing water supply regulations to require corrective measures at sites where serious water quality impacts have been documented[2].
   b. DWM will work with DFA with respect to the acquisition of agricultural lands for water supply protection.
3. DWM will rely on efforts by DEP and other groups to promote reduction of chemicals for lawn care by homeowners in the watershed.
4. DWM will continue to network with New York City DEP and other water supply agencies to keep informed of agricultural BMP issues.

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[2] DEP Division of Water Supply regulations (310 CMR 22.20B) include a provision regarding livestock near water supply tributaries ".and no hitching or standing place for horses, cattle or other animals shall be located, constructed, or maintained within 100 feet of the high water mark of such source water supply or tributary thereto." DEP has not, however, had an active involvement in enforcing this provision or coordinating with DFA.

6.3 Wastewater Disposal

Accomplishments:

- DWM has upgraded two on-site septic systems servicing the Administration complex and the Quabbin Tower restrooms. Four new leaching facilities have been installed utilizing in-house design and construction expertise. Septic systems inspections conducted in accordance with Title 5 are performed annually on each of the twelve on-site systems owned and operated by the DWM.
- DWM has begun three on-site septic systems upgrades at the Ware River Field office, New Salem headquarters, and MDC/DWM Fishing Area III. These upgrades are scheduled for completion by Fiscal Year 2001.
- Staff worked to relocate an existing Mass Highway Department maintenance facility on MDC/DWM owned land next to Long Pond in Rutland.
- DWM staff worked with local Boards of Health (BOHs) to repair a community septic system and eliminate two point source discharges.
- DWM worked with several local BOHs to review system plans and construction monitoring.
- DWM improved interagency coordination regarding Title 5 implementation with Central and Western regions of DEP's Bureau of Resource Protection
- DWM staff worked to administer the Watershed Protection regulations which place capacity and location limitations on some new systems and proposed expansions to existing systems.
- Staff attended several training sessions for the revised Title 5 regulations.

Assessment:

- There are no wastewater treatment plant discharges in the Quabbin Reservoir watershed or in the Ware River watershed.
- DWM will document which on-site systems in the watersheds threaten the water supply. Title 5, supplemented by DWM watershed sanitary surveys and other efforts, will help address isolated individual or neighborhood-level problems.

Key Activities:

- Continue and expand upon activities aimed at monitoring new and existing on-site systems including: septic system database, education, technical assistance to BOH and residents with problems, monitoring of Title 5 activity and enforcement.
- Assess existing on-site systems based on reports of septic system failure.
- At the midpoint of the five-year period, evaluate DWM's role with respect to on-site system management, factoring in the findings of the efforts presently underway, and make adjustments to activities accordingly.

Wastewater disposal is an important part of modern society's infrastructure. Technologies have advanced to treat and dispose of wastewater in methods protective of public health and the environment. Still, in the context of a drinking water supply, wastewater disposal is a potential source of contamination. On-site wastewater systems (cesspools or septic systems) represent dispersed flow discharging to the ground. Properly functioning on-site systems should not cause bacterial contamination of groundwater, but various problems, including inadequate designs, poor site soils, and high groundwater, can cause on-site systems to introduce pollutants to surface or ground waters. In addition, on-site systems can be a cumulative source of nutrients, depending upon density and site conditions.

In the Quabbin Reservoir watershed and Ware River watershed, there are no sewage treatment plant discharges. Nearly all the watershed residents, approximately 10,100 persons, use on-site systems (MDC, 1999).

The principal body of regulations governing the design, installation, operation, and maintenance of on-site wastewater disposal systems in Massachusetts is Title 5, codified at 310 CMR 15.00. Title 5 is promulgated and administered statewide by DEP and by the Boards of Health at the local level. Local boards are limited to review and approval of systems designed for less than 10,000 gallons per day (gpd) average flow. On-site systems with design flows in excess of 10,000 gpd must be reviewed and permitted directly by DEP.

MDC/DWM has historically been accorded enforcement powers over on-site wastewater disposal systems. These powers are equal to the powers of the Department of Public Health (DPH), which is DEP's predecessor agency. Under the current institutional and legislative arrangements governing on-site systems, DWM has focused its efforts and resources on identifying problem areas, using water quality monitoring and sanitary survey data. DWM refers enforcement issues to the appropriate BOH and/or DEP office providing technical assistance to BOHs and property owners, and prioritizing areas in need of planning. Recently, DWM has encouraged the formation of lake associations to address the unique issues involving septic systems servicing waterfront properties in the watersheds.

In addition to Title 5, MDC/DWM is responsible for administering the provisions of the Watershed Protection regulations (350 CMR 11.00). These regulations include specific siting restrictions for on-site wastewater disposal systems with respect to distances from water bodies and potential groundwater aquifers. The regulations prohibit new septic systems within 200', and limit septic flows within 400' of mapped surface waters and tributaries. Older, failed systems may be upgraded to current standards, but with no increase in flows beyond the density limitations in the regulations.

6.3.1 Program to Date

6.3.1.1 History

For many years, DWM has considered on-site wastewater disposal systems to be the most significant potential source of pathogens and other pollutants of concern within the MDC/DWM watersheds. In the early 1930s, MDC constructed sewers for portions of Holden and Rutland, which transferred wastewater out of the Ware River and Wachusett Reservoir watersheds for treatment and disposal. From the 1930s to the early 1980s, MDC did not have a substantial role in addressing the remaining portions of the watershed served by on-site systems. In 1985, when the MDC's Division of Watershed Management and the Massachusetts Water Resources Authority were created, the Watershed Protection Strategy targeted wastewater as a top priority.

6.3.1.2 Current Program and Accomplishments

1991 Plan

The 1991 Plan continued to focus attention on septic systems. The Plan identified a range of measures to be undertaken by DWM:

- Provide technical assistance to BOHs to repair/replace failing systems and ensure strict enforcement of Title 5.

- Develop model BOH regulations. In 1995, this became unnecessary with DEP's revision of Title 5.

- Limit density of new on-site systems through the WsPA.

- Provide information on septic system maintenance to BOHs and homeowners.

Progress

Since the development of the 1991 Plans, the Division has made significant progress on each of these items. DWM put significant effort into establishing effective working relationships with local BOHs and local engineers.

- DWM's staff attends Rutland Board of Health meetings monthly. DWM's provides limited technical assistance and facilitates an open line of communication with volunteer Board members. DWM staff also provided technical review assistance to the Hubbardston Board of Health for the repair of a community septic system, and to the Petersham Board of Health to eliminate two point discharges of septic effluent to the ground surface.

- Many engineers and septic system designers now routinely forward their plans on WsPA affected parcels to DWM staff for review prior to submission to the local BOHs. Numerous BOHs now require DWM review prior to their own approval of systems on affected parcels.

On-Site Systems

DWM has worked with DEP, Boards of Health, and the UMass Cooperative Extension Service to provide education to the public with regard to septic system maintenance and repair, financing alternatives, changes to Title 5 regulations, and related issues. Specific on-going projects related to remediation and control of on-site wastewater disposal are detailed below.

Pilot On-site Wastewater Management District Project

Most areas of the watershed, due to low to moderate housing densities, will continue to be served by on-site systems. DWM is conducting a legal and technical analysis to identify approaches to local waste management districts. (A portion of the town of Rutland is sewered in the Ware River watershed. Sewer expansions in this area are occurring mostly to facilitate increased housing density in a limited area. In Rutland, a developer outside of the existing sewered area has he option of extending, at his own expense, the sewer line to his proposed development, in order to increase his development density.

The pilot project began as a watershed-wide effort coordinated with the BOH Coalition in the Wachusett watershed. Based on interest, the project focused on the Towns of Holden and West Boylston as a model. Various alternative districts were evaluated. The project's final result is an outline of a petition to the legislature to form a wastewater district, which could be townwide or on a neighborhood scale.

Wastewater district concepts provide institutional and financial framework as an important alternative to the traditional homeowner-BOH relationship. Districts are common for sewers and sewage treatment plants and, while less common for on-site systems, have been successfully implemented elsewhere. A district approach could yield significant benefits to both BOHs and individual property owners in ensuring and accomplishing maintenance, inspection, pumping, repair or replacement, and system upgrading. Without a district approach, homeowners act individually and bear the entire financial burden of any required repair or replacement. The cost can be economically catastrophic depending on the home's value and mortgage amount. DWM has completed the contract and will continue to work with interested communities and neighborhoods.

6.3.2 Assessment

On-site wastewater disposal systems continue to represent potential sources of pathogens and other pollutants of concern to the water supply. The on-site system discharges pathogens, nutrients, dissolved solids, organic and inorganic salts, and other chemicals used in the home or business to the ground. If inadequately treated, these pollutants may eventually appear as surface water pollution in the tributaries throughout the watershed system and/or migrate via groundwater pathways.

On-site wastewater disposal is an accepted method of wastewater disposal in a water supply watershed, provided that such systems are designed, operated, and maintained in compliance with the Title 5 requirements, and that water quality is not impaired. Within the portions of the watershed using on-site systems, there are some individual lot problems and isolated neighborhood problems.

Title 5 revisions of 1995 represent a major regulatory improvement to address existing on-site systems. In cases of significant failure (e.g., surficial failure or obvious water quality impact), Title 5 has provisions for immediate action and enforcement. Where individual lots cannot replace a problem system in conformance with Title 5 conventional systems, due to lot size or soil conditions, Title 5 alternative technologies may be the solution. Title 5 also addresses less obvious or visible problems with existing systems by requiring inspections and system repairs with property transfers. Also, Title 5 and the Watershed Protection regulations prevent the installation of new on-site systems in sensitive areas (e.g., within 200' of a public water supply tributary or source water).

6.3.3 Control Approach

Property owners, Town Boards, DEP, and DWM each have a role in the proper control of wastewater in the watershed. Together, these entities need to take responsibility for implementing the following elements to form a comprehensive, watershed-based approach to on-site waste management:

- Monitoring and Identification of Problem Systems
- Title 5 and Watershed Protection Regulations Administration
- On-Site System Maintenance, Pumping and Inspection (O&M)
- On-Site System Repair/Replacement
- Septage Disposal and Accounting
- Record keeping & Reporting
- Enforcement

DWM’s approach to controlling wastewater disposal incorporates each of these elements, as depicted in **Table 6-5.**

Table 6-5

Programs to Ensure Properly Operating On-Site Wastewater Systems

Component	*Title 5 Administration By BOH and DEP*	*Technical Assistance to BOH and Homeowners*	*BOH Septic System Database*	*Sanitary Inspections and Water Quality Monitoring*	*Evaluate MDC/DWM Role and Funding Issues*	*Public Education*
Identify Problem Systems						
➢ Neighborhood Level		✓	✓	✓		
➢ Excess Pumping		✓	✓			
➢ Fail Inspection at Property Transfer	✓		✓			
➢ Surface failure		✓		✓		
Determine Best Solution to Comply with Title 5 Given Lot Conditions	✓					
Implement Solution	✓				✓	✓
Proper Operation and Maintenance					✓	✓

Source: (MDC/DWM, 1998)

6.3.3.1 Goals

DWM’s goals for wastewater management are to:

- Maximize DWM’s ability to control the potential water quality impacts from wastewater disposal.
- Remediate all identified water quality problems associated with wastewater disposal in the water supply watersheds, through repair or replacement of failing or inadequate on-site disposal systems.
- Minimize through education and outreach, the potential impacts of wastewater disposal on the waters of the watershed system.
- Protect existing high-quality water resources from any degradation due to wastewater disposal in the watershed system.

6.3.3.2 Five-Year Objectives

DWM's five-year objectives for wastewater management are:

1. Complete projects already underway that will develop more information concerning both the condition of on-site systems in the watershed and approaches to remediation where needed,

2. Expand public education about solutions to on-site system problems as well as proper operation and maintenance, and

3. Evaluate its role with respect to management of on-site systems with the Boards of Health and DEP in the watersheds of the Quabbin Reservoir and Ware River.

6.3.3.3 Activities

Activities scheduled to occur over the five-year time horizon of this Plan Update focus on DWM's approach to controlling impacts from on-site wastewater systems.

1. Develop and distribute public education materials on: a) solutions to on-site system problems, b) proper operation and maintenance, and c) financing options.

2. Provide technical assistance to towns and/or neighborhood associations to consider/evaluate on-site wastewater management district.

3. Initiate Septic System Database Project.

    a. Link the parcel-specific database with DWM's GIS database.

    b. Provide follow-up training and assistance to BOHs to make the best use of what will be a comprehensive collection of septic system information for each community.

    c. Using the database, identify and track potential problem systems and follow up with owners and BOHs.

4. Continue to monitor and enforce the provisions of Title 5 with BOHs and DEP, including consultation with BOHs, review of local BOH filings, plan review, performance of site visits, water quality monitoring, and follow-up sampling where problems are indicated. Continue to attend BOH meetings monthly or bimonthly, with individual DWM EQ staff "assigned" to each BOH in the critical towns. Under the terms of the upcoming enforcement protocol, work with BOHs and DEP to enforce Title 5. Target chronic problem systems in sub-basins with affected water quality.

5. Provide technical and, where appropriate, funding assistance to towns on wastewater disposal.

6. At the mid-point of this Plan Update, prepare an analysis and evaluation of the most appropriate role for DWM to achieve proper on-site system management throughout the watershed. Consider an expanded role for MDC/DWM in ameliorating those priority problem sites.

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6.4 Stormwater

Accomplishments:

- DWM has implemented and monitors stormwater BMPs in both watersheds in partnership with MassHighway, including the Burnshirt Road reconstruction, Rte. 62 resurfacing, road widening projects, as well as a bridge reconstruction in New Salem, to divert and disperse concentrated highway runoff. Staff has designed stormwater BMPs (e.g., modified outfalls) for additional sites.
- DWM has provided technical assistance to several watershed municipalities, local Conservation Commissions, and state agencies to strengthen local stormwater controls, as well as to increase understandability of DEP's Stormwater Management Policy, especially related to subdivision projects. MWRA's transportation crew has provided technical assistance.
- MDC/DWM Watershed Maintenance crew has managed stormwater on over 200 miles of internal dirt/gravel roads and corrected stormwater outfall areas near MDC/DWM facilities.
- DWM's administration of the WsPA requires erosion and sedimentation control plans for development proposals within regulated areas and limits impervious cover to 10% of lot in the Primary Protection Zones.
- Division staff attend DEP Stormwater Management Training workshops.

Assessment:

- Pathogens transported in stormwater are the highest priority concern; nutrient loading and sedimentation are considered second highest concerns.
- Piped drainage from residential subdivision road networks tend to concentrate road sand/salt, petrochemicals, and fertilizers from lawn care.
- Both watersheds contain lakes with developed shorelines with many summer camps. DWM staff have observed a trend for conversion of summer camps to year-round occupancy, which can compromise valuable riparian zones.

Key Activities:

- Prepare Stormwater Project List in each watershed.
- Prioritize DWM stormwater BMP implementation by subbasin in each watershed.
- Monitor the stormwater BMPs in place. Apply successful techniques in additional locations.
- Continue to implement stormwater BMPs as needed.
- Coordinate with interested local communities to design Town-wide Stormwater Plans.

6.4.1 Program to Date

6.4.1.1 History

Through the 1970s and 1980s, environmental professionals became more aware of non-point source pollution associated with stormwater due to research and studies, such as those undertaken by EPA's Nationwide Urban Runoff Program. Since the mid-1980s, DWM documented stormwater related impacts to the Quabbin Reservoir and Ware River through sanitary surveys. DWM also recommended and implemented corrective actions through that process on a case-by-case basis.

In recent years, several significant regulatory policies emerged focusing on stormwater. These include the application of the National Pollutant Discharge Elimination System (NPDES) program to urban stormwater and stormwater from certain types of sites, and the Massachusetts Stormwater

Management Policy. **Table 6-6** lists the regulations most relevant to stormwater.

Table 6-6

Key Acts and Regulations Aiding Control of Stormwater

Federal

- Federal Clean Water Act, Sections 401 - relates to certification of ‘discharges’
- Federal Clean Water Act, Sections 402 - relative to point source discharges
- Federal National Pollutant Discharge Elimination System - discharges associated with industrial activity

State

- Massachusetts Wetlands Protection Act - alteration of areas within 100' of wetlands and 200' of streams
- Massachusetts Watershed Protection Act - alteration of areas within 400' of designated tributaries
- Massachusetts Surface Water Quality Standards - compliance with specific water standards
- Massachusetts Stormwater Management Policy - limits development impacts-80%Total Suspended Solid (TSS) removal
- Massachusetts 401 Water Quality Certification - State certification of ‘discharges’
- Massachusetts Pesticide Regulations - limit application near tributaries
- Massachusetts Forest Cutting Practices Act – requires unaltered buffer strips

Local

- Local Subdivision Control Laws - includes stormwater system design and erosion controls
- Local Erosion and Sediment Control Laws - defines erosion and sediment controls
- Local Earth Removal Laws - includes erosion and sediment controls
- Local Site Plan Approval Laws - includes stormwater system design and erosion controls

Source: (MDC/DWM, 1998)

6.4.1.2 Current Program and Accomplishments

1991 Plan

The 1991 Plan addressed stormwater as a water quality threat in three sections. Section 4.2.3 of that plan, Urban Runoff, noted that negative impacts were generally related to flooding and urbanization from newly developed areas, illegal discharges to storm drains, and at specific discharge locations. Recommendations included:

- Use Stormwater BMPs on new development.
- Limit impervious cover in sensitive zones.
- Evaluate specific structural stormwater treatment controls.
- Disconnect illegal floor drains.

Stormwater is regarded as a conduit to the reservoir for pollutants under **Section 4.2.12**, Construction. Under that section, the plan recommends DWM promote the design and implementation of erosion and sedimentation control techniques for development proposals, and aid in the local review and inspection of construction activities. Finally, under **Section 4.2.20** Erosion, the naturally occurring erosion within the watershed is identified as a source of pollutants to the water supply.

Overview

Starting with the broadly defined recommendations in the 1991 Plan, DWM conducted various planning, implementation, and research projects. At this point, DWM will take advantage of a comprehensive stormwater program from the Wachusett watershed including these key elements:

- Providing local boards with training, reference materials, and site-specific guidance concerning Stormwater BMPs to control stormwater from new construction (in conjunction with the Community Technical Assistance program) (see **Table 6-7** and **Section 5.3**);
- Working cooperatively with MHD and local DPWs regarding road and highway drainage (see **Section 7.1**);
- Limiting development within 400 feet of tributaries, surface waters, and floodplains via the WsPA (see **Section 5.1**);
- Implementing, monitoring, and correcting, if necessary, erosion and sedimentation controls for development proposals;
- Working with DEP's UIC program to inspect and eliminate floor drain discharges from facilities generating hazardous waste;
- Supporting and commenting on state regulations and policies that assist in controlling stormwater impacts: the River Protection Act of August 1996, the DEP Stormwater Management Policy effective August 1996, and Massachusetts Environmental Policy Act (MEPA) revision, 1998;
- Conducting research to better characterize stormwater in Wachusett Watershed; and
- Evaluating and implementing structural stormwater controls.

Table 6-7

Stormwater-Related Community Technical Assistance

Item	*Towns*
Three Watershed Protection Workshops: "Implementing BMPs" (October 1993; presented by Tom Schueler)	All
Erosion and Sediment Control Manual (1994)	All
Presentations on Erosion and Various Sediment Control Measures (1993-present)	Rutland
Presentations at Massachusetts Association of Conservation Commissions: "Construction Site Erosion Control" (1996) "River and Stream Protection" (1997) "Erosion Control for Difficult Sites" (1998)	All

Source: (MDC/DWM, 1998)

Many aspects of DWM's stormwater approach overlap with other areas, such as technical assistance, highways, and construction. DWM's goals, objectives, and activities for these specific sources are discussed in those sections of this Plan Update (**Sections 5.3**, **7.1**, and **7.4**, respectively). The stormwater approach acts as an umbrella to coordinate these elements. Within the stormwater program itself, efforts focus on the last two items, research and implementing stormwater treatment controls. These activities are further detailed below.

Research

Subbasin Monitoring: The Quabbin Environmental Quality Section has subdivided into sub-basins Quabbin Reservoir Watershed's four sanitary districts and the Ware River watershed's four sanitary districts, which are surveyed in a five-year rotation. These sub-basins were derived as distinctly different catchments with sample sites so that actions conducted within the sub-basins can be directly associated with water quality results at the sample points. Within the Sanitary Survey program, these sub-basins are inspected, and activities and conditions within each subbasin are reviewed in detail, to identify relationships with the water quality data (see **Section 8.3**).

Ware River Watershed Land Acquisition Model – Time of Travel: DWM completed this study with UMass Amherst. The study included a land sensitivity model with a travel time component used to quantify time-of-travel for pollutants from a location in the watershed to the outlet. DWM will use this model to help prioritize land acquisition decisions, in-house resource allocation, and other land management decisions within the Ware River watershed.

6.4.2 Assessment

Depending on the materials that rainfall/runoff encounters in its path, stormwater may contain many pollutants, such as sediment/solids, phosphorus, nitrogen, metals, pathogens, petroleum hydrocarbons (PHCs), and synthetic organics, such as solvents, pesticides, etc. The temperature, pH, and dissolved oxygen of streams may also be altered.

The highest priority parameters for control are pathogens, which can be transported to tributaries or the reservoir by stormwater from improperly treated wastewater or animal (both domestic and wild) populations. Nutrient loading and sedimentation are considered to be the next level of concern. These pollutants are present in any watershed, but typically increase with urbanization, and result in chronic, irreversible changes to water quality, with water supply treatment implications.

Stormwater as a 'pollution source' is difficult to describe because it is the transport mechanism for pollutants generated from other sources. The land uses of each subbasin are the principal characteristic determining the quality and quantity of stormwater destined for the reservoir. The MDC/DWM's Wachusett Stormwater Management Study assessed the relationship between storm sampling data and the land uses within the areas tributary to the sample sites. The study found that the pollutant loads are fairly low for most Wachusett sub-basins. The study also found that agriculture was the land use most significant to higher stormwater pollutant loads. These findings can be applied to the Quabbin and Ware sub-basins.

6.4.3 Control Approach

6.4.3.1 Goals

Pollution threats from stormwater result directly from the activities and land use occurring within the drainage basin. Therefore, a primary DWM goal is to reduce the pollutants at the source, before they can be transported by stormwater, as reflected in DWM's source-specific programs (e.g., agriculture, wastewater, etc.).

As the transport mechanism for those pollutants, the stormwater systems will be assessed to locate conditions and methods of treating the stormwater before it is discharged to the reservoir. The goal of the stormwater program is to improve existing treatment mechanisms or install treatment practices that will minimize pollutant loading to the reservoir, eliminate illegal discharges, and ensure compliance with regulatory conditions.

6.4.3.2 Five-Year Objectives

DWM's primary objective for the stormwater program in the next five years is to prepare Quabbin and Ware Stormwater Project Lists, prioritizing stormwater treatment projects and other stormwater BMPs in the context of monitoring and modeling results, and implementing them according to the schedule. DWM's stormwater program objectives also include:

1. Prioritize stormwater protection efforts on MDC/DWM-owned property. Recommend application of known technologies to specific sites.

2. Continue to review plans for highway reconstruction projects and make recommendations for stormwater BMPs, as appropriate.

3. Prioritize stormwater protection efforts by subbasin to get the most improvement in Reservoir water quality. Recommend specific sites and/or mechanisms to attain the improvements. Establish goals and milestones for each subbasin.

4. Encourage and aid interested local communities to design town-wide Stormwater Plans which will incorporate specific suggestions in regard to zoning and bylaw changes, as well as flooding and drainage improvements that would include water quality enhancements.

5. Make specific recommendations for stormwater improvement projects to be completed both by MDC/DWM staff and through consultant and/or construction contracts.

6. Designate future studies and mapping initiatives necessary to clarify current conditions or processes that are unknown at this time and are needed to proceed in improving water quality from stormwater (e.g., stormwater system mapping, hydrodynamics of the reservoir, etc.).

7. Assess changes to the current stormwater and routine water sampling programs to improve characterization of loading associated with stormwater.

8. Characterize process to assess impact of residential fertilizer application on nutrient loads in reservoir.

9. Address staffing and budget needs for implementation of recommendations.

6.4.3.3 Activities

In order to achieve the five-year objectives, the following activities will be undertaken:

1. Stormwater Planning
    a. Assess recommendations of Wachusett Stormwater Management Study (CDM). Apply to the watersheds of the Quabbin Reservoir and Ware River.
    b. Coordinate with interested towns to develop townwide Stormwater Plans.
2. Stormwater Project List
    a. Develop Stormwater Project Lists; show priorities and target timeframes for top priorities.
    b. Update Project List reflecting new information; especially technology evaluations such as stream restoration, stormwater treatment cells, barrier curtains, and filter curtains.
3. Stormwater BMP Implementation
    a. Implement minor stormwater BMPs around the reservoir including Stormwater BMPs to address erosion and sedimentation due to public access and stormwater runoff and shoreline erosion.
    b. Construct stormwater BMPs on MDC/DWM property, in accordance with set priorities.
4. Other
    a. Advise local boards about Massachusetts Stormwater Management Policy.
    b. Coordinate with MHD to improve water quality from State highway drainage.

6.5 Visitor Sanitation

Accomplishments:

- Completed study of visitor sanitation patterns in the Quabbin Reservation.
- Installed and maintains 22 seasonal use portable sanitary toilets in high use and strategic remote locations in both the Quabbin Reservoir and Ware River watersheds for day-visitor use.
- Require the use of portable toilets in all forestry contracts.

Assessment:

- Visitor sanitation management is a critical concern in MDC/DWM's overall pathogen prevention program.

Key Activities:

- Monitor and adjust the visitor sanitation program according to shifting visitor patterns.
- Evaluate the siting and functionality of existing portable sanitary toilets.
- Continue public education and outreach efforts.

6.5.1 Program to Date

6.5.1.1 History

Prior to 1991, the MDC/DWM provided very limited facilities for visitor sanitation within the Quabbin Reservoir watershed. The only year-round, permanent facility was located at the Quabbin Visitor Center in Belchertown. The remaining five sanitary facilities were located in the Quabbin Reservation and Quabbin Park and available only seasonally (fishing season). In Quabbin Reservation, each boat launch area had a facility. In Quabbin Park, the Quabbin Tower and the Winsor Dam each had a sanitary facility located nearby. There were no MDC/DWM maintained sanitary facilities for the public on MDC/DWM lands in the Ware River watershed prior to 1991.

6.5.1.2 Current Program and Accomplishments

MDC/DWM is specifically concerned with the potential water quality contamination threat and associated public health risk caused by improperly disposed of fecal matter (human and animal) caused by visitors to DWM's drinking water supply lands and waters. In response to documented evidence of improperly disposed of fecal matter along shoreline areas and watershed areas, DWM staff developed a Pilot Sanitation Plan in 1993 for MDC/DWM's lands in the Quabbin Reservation. The objective of the Plan was to identify successful procedures and methods for controlling the threat of improperly managed human sanitation in remote areas, and correcting problems with existing facilities in the Quabbin Reservation and on MDC/DWM lands in the Ware River watershed.

1991 Watershed Protection Plan

The 1991 Plan identified human sanitation problems related to recreational activities in Quabbin Reservation. The primary sanitary problems were identified at the Quabbin Boat Launch Areas and on the shorelines of the Quabbin Reservoir near Gates 16, 22, 29. 35, and 40. The long length of stay (e.g., 5-7 hours) and the limited number of sanitary stations (one at each boat launch area) results in problems along the shoreline and other locations. At the time, sanitary waste facilities were not provided on DWM lands in the Ware River watershed because of the lack of concentrated recreational activities (like the fishing area program).

MDC/DWM's Pilot Recreational Sanitation Study – Quabbin Reservation

Between May 22 and November 1, 1992, DWM staff installed and monitored five portable chemical toilets located in the Quabbin Reservation in five different locations. EQ staff sited the facilities, monitored their function, conducted a "use" questionnaire, and evaluated the findings. The DWM's Interpretative Services staff encouraged the use of the temporary sanitary facilities during educational programs. **Table 6-8** illustrates the numbers of responses from various user types at various locations. Night users and employees rarely completed the questionnaires. The majority of the visitors felt that the portable rest rooms were a good idea. According to the final assessment of the pilot program and staff recommendations in the study, the DWM has now installed additional portable sanitary facilities and has initiated a formal Visitor Sanitation Program (**Table 6-9**).

Table 6-8

Temporary Sanitary Facility Locations, User Type, and User Distribution
DWM Pilot Sanitary Study – Quabbin Reservation, 1993

	Visitors at MDC/DWM Portable Sanitary Toilets Locations					
User Type	*Purgee Brook*	*Gate 16*	*Shaft 11A*	*Shaft 12*	*Dana Common*	*Totals*
Day Hiking	53	46	24	43	102	268
Boat Fishing	41	12	NA	NA	NA	53
Cycling	6	2	4	23	60	95
Shore Fishing	3	30	12	5	NA	50
Other	3	12	6	9	11	41
Totals	**106**	**102**	**46**	**80**	**173**	**507**

Source: (MDC/DWM, 1993)

Siting and Maintenance of Sanitary Facilities

Currently, MDC/DWM has installed (or sited) and monitors twenty-seven sanitary facilities to manage visitor sanitation in the Quabbin Reservoir watershed and four facilities in the Ware River watershed[3]. Some facilities are permanently installed (typically for DWM personnel only), but most are temporary because they are used for seasonal activities. The temporary facilities are sited based on visitors and fishermen patterns in remote locations. Other facilities are positioned to specifically serve a combination of visitors in highly frequented locations. The following discussion outlines the various types and location of sanitary facilities used by visitors, boaters, loggers, and DWM personnel while on DWM water supply lands. **Table 6-4** outlines the current distribution of sanitary facilities managed by MDC/DWM in both the Quabbin Reservoir and Ware River watershed.

Permanent Sanitary Facilities – Quabbin Reservoir Watershed

DWM staff completed design work and installation of three permanent sanitary facilities within the Quabbin Park and Quabbin Reservoir watershed. In 1997, the Quabbin Tower septic system was upgraded and put on-line in 1998. The Administration Building septic system was upgraded and put on-line in 1995. And in 1999, the Fishing Area #1 septic system was replaced by a universally accessible modular unit using the existing system.

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[3] In addition to MDC/DWM maintained facilities, 7 other facilities are operated in the Ware River watershed by the MDFW's Public Access Board (2-seasonal), DEM (3-seaonal), and ACE (2- year round).

Portable Sanitary Facilities – Quabbin Reservoir Watershed
Currently, DWM staff monitors 15 portable sanitary facilities within Quabbin Reservation. Nine facilities support the fishing area program. Six portable facilities are used primarily by visitors such as day hikers or birder watchers.

Portable Sanitary Facilities – Ware River Watershed
Currently, the Division operates and monitors two portable sanitary waste facilities near Comet Pond, a highly visited area, in Hubbardston, Massachusetts. In addition, there are two public sanitation facilities within the interior of DWM lands in the Ware River Watershed. The U.S. Army Corps of Engineers operates permanently installed restroom facilities (year round use) at the Barre Falls Dam complex in Barre. The MA DEM operates and maintains another facility at the Rutland State Park in Rutland, Massachusetts. The MDFW's Public Access Board operates and maintains two temporary portable facilities on Comet Pond and Long Pond boat access ramps.

Other Events
The disposal of human waste is prohibited on the MDC/DWM watersheds. Therefore, DWM also controls sanitation issues with loggers, or any work crew on DWM lands and during discrete events (e.g., opening weekend of the fishing season). MDC's forestry contract specifications require the use of a portable bathroom facility (a minimum of a "Coleman" chemical toilet). The only exception to this policy is the use of existing sanitary facilities on the watershed. When necessary, and appropriate, the DWM installs portable sanitary facilities for special events or unusual circumstances. For example, during the opening weekend of the fishing season, when numerous fishermen wait to gain access to the fishing areas, DWM installs for the weekend, two portable facilities for the crowds waiting in front of the access gates of each fishing area.

Table 6-9

MDC/DWM Flush and Portable Toilets
Quabbin Reservoir Watershed and Ware River Watershed (1999)

Location	*Flush Toilets (Permanently Installed)* Year-round use	Seasonal Use	*Portable Toilets (Temporarily Installed)* Seasonal Use
Quabbin Park	2	2	6 (3 handicap accessible)
Fishing Area #1	NA	2 (handicap accessible)	1
Fishing Area #2	NA	2	1 (handicap accessible)
Fishing Area #3	NA	2	1 (handicap accessible)
Quabbin Reservation – Various Locations	NA	14	Varies annually – See Special Events below
Ware River Watershed – Comet Pond	NA	NA	2 (handicap accessible)
DWM Field Offices (New Salem, Oakham)	2 (employee use only)	NA	NA
Total	***4***	***32***	***11***

Source: (MDC/DWM – EQ, 2000)
Special Events include Fishing Area Opening and MDC/DWM Controlled Deer Impact Management Program.

Additional Pathogen Prevention Measures

Currently DWM allows limited horseback riding on designated trails, during designated times, on DWM lands in the Ware River watershed, with specific restrictions on manure management (see *MDC/DWM Public Access Management Plan Update – Ware River Watershed*). These designated trails are monitored and evaluated by DWM staff. Currently, horse feces within sight of any tributary or surface water must be removed or buried by the riders in a group with less than fifty riders. MDC/DWM requires more complex manure management techniques by groups with more than fifty riders. In addition, DWM staff have distributed designated trail maps, installed trail markers, and conducted extensive public outreach activities regarding public access on drinking water supply lands. In addition, DWM maintains the Watershed Ranger patrol in the Ware River watershed, to reduce and prevent the public health threat from improperly disposed sanitary waste matter from the public's access to DWM lands and waters.

6.5.2 Assessment

With the increasing recreational access pressures on undeveloped lands, decreasing recreational space in Massachusetts, and the shifting demographics in Central Massachusetts, the intensity (both frequency and duration of visits) of visitor sanitation is an increasing threat on DWM's drinking water supply lands. In response, the DWM's visitor sanitation management activities are a priority in MDC/DWM's pathogen prevention program.

6.5.3 Control Approach

6.5.3.1 Goals

- Prevent improperly disposed sanitary waste (e.g., fecal matter and urine) from human and domesticated animals, from posing a threat to water quality of tributaries of the water supply.

- Enhance the MDC/DWM Visitor Sanitation Program to respond to changing visitor patterns.

6.5.3.2 Five-Year Objectives

For the next five years, DWM's objectives for visitor sanitation management program are:

1. Continue to control improperly disposed sanitary waste by maintaining and monitoring sanitary facilities (permanent and portable toilets) in strategic locations on DWM's lands in the Quabbin Reservoir and Ware River watersheds.

2. Continue to reduce the likelihood of improperly disposed of sanitary waste through educational efforts with user groups, outreach to watershed communities, etc.

6.5.3.3 Activities

MDC/DWM will meet these objectives through these activities:

1. Work with DEP to improve the DWM's sanitary waste management activities.

2. Monitor and assess visitor use and patterns to adjust Visitor Sanitation Program accordingly. As part of this effort, DWM will conduct a needs assessment for DWM lands on the West Branch of the Swift River.

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Section 7
Site-Specific Controls

This section describes the various ways that DWM controls hazards associated with site-specific threats in the watershed including: highways, railways, and utility rights-of-way; individual contaminated/suspected sites; and construction sites. It also discusses emergency planning and response, an issue relating to accidental spills and releases from highways, railways, rights-of-way maintenance, and individual contaminated/suspected sites. The information presented in the previous plan has been updated and expanded to present a more comprehensive assessment of each topic. There is additional information elsewhere in this plan: regulatory aspects are presented in **Sections 5.1** and **5.2**; community relations aspects in **Sections 5.3** and **5.4**; and assessment through watershed sanitary surveys in **Section 8.3**. The 1991 Plan for Quabbin Reservoir and Ware River watersheds (MDC, MWRA and Rizzo Associates, 1991b) covered most of these topics in various sections, as described below in **Table 7-1**.

Table 7-1

Topics Covered in Section 7 and Their Relationship to 1991 Watershed Protection Plan

Title in MDC/DWM 2000 Watershed Protection Plan Update	*1991 Quabbin Reservoir and Ware River Watershed Protection Plan*		
	Section	*Title*	*Description of Section Discussion*
Highways, Railways, And Utility Rights-of-Way (Section 7.1)	4.2.8	Urban Runoff	Minimizing pollutant loads in runoff from newly developed areas and improve quality of existing runoff
	4.2.3	Uncontrolled Releases - Transportation	Minimizing the risk of transportation incidents that could release contaminants into the water supply
	4.2.11	Pesticide, Herbicide and Fertilizer Usage	Prohibiting use of chemicals on sensitive lands; monitoring vegetation management along highways, railways, and utility rights-of-way (ROW)
	4.2.20	Road Salting	Minimizing salt usage and monitoring salt storage areas
Individual Contaminated/ Suspected Sites (Section 7.2)	4.2.12	Gasoline/Petroleum Storage	Inventorying Underground Storage Tanks in the watersheds and remediating releases where they have occurred
	4.2.19	Uncontrolled Releases - Fixed Site	Remediating sites where hazardous waste contamination exists; promoting proper handling and disposal of hazardous materials
	4.2.13	Permitted Activities - Solid Waste Facilities	Ensuring proper closure and monitoring of existing landfills, and prohibiting siting of new facilities in sensitive areas
	4.2.14	Permitted Activities - Hazardous Waste Generators	Ensuring hazardous waste generators stay in compliance with applicable rules and regulations
Emergency Planning and Response (Section 7.3)	4.2.3	Uncontrolled Releases – Transportation	Minimizing risk of transportation incidents which could release contamination
	4.2.19	Uncontrolled Releases - Fixed Site	Maintaining capability to respond effectively to a hazardous waste spill
Construction Sites (Section 7.4)	4.2.10	Construction	Ensuring appropriate erosion control measures are used in construction sites and improving capability of municipalities to review, monitor, and regulate
Gravel Mining (Section 5.1)	4.2.9	Gravel Mining	Prohibiting gravel mining in sensitive areas and promoting increased control and monitoring of sites

7.1 Highway, Railway, and Utility Rights-Of-Way

Accomplishments:

- Developed an Emergency Response Plan (for Hazardous Materials release) and conducted training for the Incident Command System (ICS) for emergency personnel in conjunction with the State Fire Marshall's office.
- Transportation Release Controls Study: Completed a report which surveyed the risks of stormwater runoff and accidental spills from roads and railways.
- Roads: Identified drainage elements, evaluated and modified proposed structural controls to disperse flows away from water resources; eliminated numerous direct discharges of highway runoff along sections of Routes 122, 62, and 202.
- Railways: Reviewed and commented on draft Vegetative Management Plan (VMP) 2000-2005 for all railroad rows throughout the Commonwealth. Reviewed, field-verified, and monitored implementation of final annual Yearly Operational Plan (YOP) for the Providence and Worcester Railroad to ensure no spray buffers were intact around sensitive water supply areas.
- Utilities: Reviewed and commented on annual YOPs for New England Electric Systems 205 and E5/F6 utility rights-of-way. Monitored implementation of YOPs on both lines.
- Developed a Memorandum of Understanding detailing a set of procedures for use with all YOPs that involve chemical applications inside the Quabbin Reservoir, Ware River, or Wachusett Reservoir watersheds between MDC/DWM and DFA-Pesticide Bureau.
- Pesticides/herbicides/fertilizers: Supported enactment of DFA regulations, received notification of major applications, implemented related MDC regulations related.
- Road salt: Established a policy supportive of salt usage to minimize threat of accidental spills; supported the use of Federal funding to eliminate outdoor salt storage.

Assessment:

- Runoff is a moderate threat, though spill/releases (see **Section 7.3**) are a high potential threat. In runoff, most significant pollutants are heavy metals and petroleum products, and less significant ones are sediments and pesticides/herbicides. Sodium from roadway salt was determined to no longer be a significant concern to the reservoir.
- Rights-of-way management is a land use activity closely monitored by DWM staff.

Key Activities:

- Transportation Release Controls Study: Complete prioritization of operational and structural protection efforts; implement recommendations.
- Roads: Improve existing infrastructure to redirect all direct discharges away from the tributaries and the Reservoir; incorporate highway Best Management Practices (BMPs) into new construction and improvement (reconstruction) of existing roads.
- Railways: Determine management opportunities for hazardous materials transport; monitor YOPs and review VMPs, as necessary.
- Utilities: Monitor YOPs and review VMPs, as needed.
- Regulations: Expand knowledge to assess rerouting options, enforce operational changes, and improve relationship with other agencies.
- Database: Compile a database of types and quantities of hazardous materials transported and chemicals used through the watershed from Federal and State agency data.

7.1.1 Program To Date

7.1.1.1 History

Figure 7-1 shows the current location of highways, railways, and utility rights-of-way in the Quabbin Reservoir and Ware River watersheds. When Quabbin Reservoir was built, a railway, numerous roads, and utility rights-of-way were relocated. With increased commercial and industrial activities in the watersheds, development and usage of hazardous materials, and new materials that are used in the operation and maintenance of rights-of-way, the threat to water quality from transportation routes and utility rights-of-way has increased since the early 1900s.

7.1.1.2 Current Program and Accomplishments

In the past eight years, DWM conducted a multi-faceted approach to minimize the risks associated with the transportation and right-of-way corridors within the watersheds. The approach consists of addressing both the drainage flows from typical road runoff, as well as the specifics of hazardous material releases and response (for emergency planning and response, see **Section 7.3**), as well as vegetative management and yearly operational management plans for right-of-ways. In implementing this approach, DWM conducted and continues to implement the following activities:

- Works with DEP and Massachusetts Highway Department (MHD) to identify critical highway and drainage system elements as part of a comprehensive emergency response system, and to coordinate efforts to design and build appropriate drainage system improvements.
- Works with DFA-Pesticide Bureau (DFA-PB) to review and monitor Vegetative Management Plans (VMPs) and Yearly Operational Plans (YOPs) for railroad and utility right-of-ways maintenance throughout the watersheds.
- Identifies sources and generators of hazardous materials.
- Educates the users and the public about the risks to the water supply posed by the use, storage, transportation and disposal of hazardous materials in the watershed system.

The following text discusses the specific actions taken in accordance with the 1991 Plan.

Roads

The 1991 Plan recommended that DWM evaluate structural controls for the following locations: Route 202, Route 122 adjacent to the Quabbin Reservoir and Ware River, and along Route 32A.

DWM determined, through studies with storm-water control expert Tom Schueler, that the construction of dispersion and infiltrating devices should be assessed based on site-specific conditions. These practices have been found to be beneficial in reducing highway pollutant loads. DWM recommended such devices be installed in areas where MHD and local Departments of Public Works (DPWs) are intending to do reconstruction, and took the following actions in specific locations:

- DWM requested design changes on MHD plans. Drainage modifications included reconstruction activities along sections of Route 122, Route 62, and 202, which have been reconfigured from concentrated discharges to dispersed flows through woodlands. On Route 62, over 20 proposed direct stormwater discharges to watershed streams were eliminated and replaced by structural controls. Along the Burnshirt River, a proposed direct storm-water discharge was replaced with an infiltration basin, after DWM review of the original design.

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MDC

Metropolitan District Commission

Major Roadways, Transmission Lines and Active Railroads

Statute Miles

0 1 2 3 4 5 6 7 8 9 10

EXECUTIVE OFFICE of ENVIRONMENTAL AFFAIRS

MASSGIS

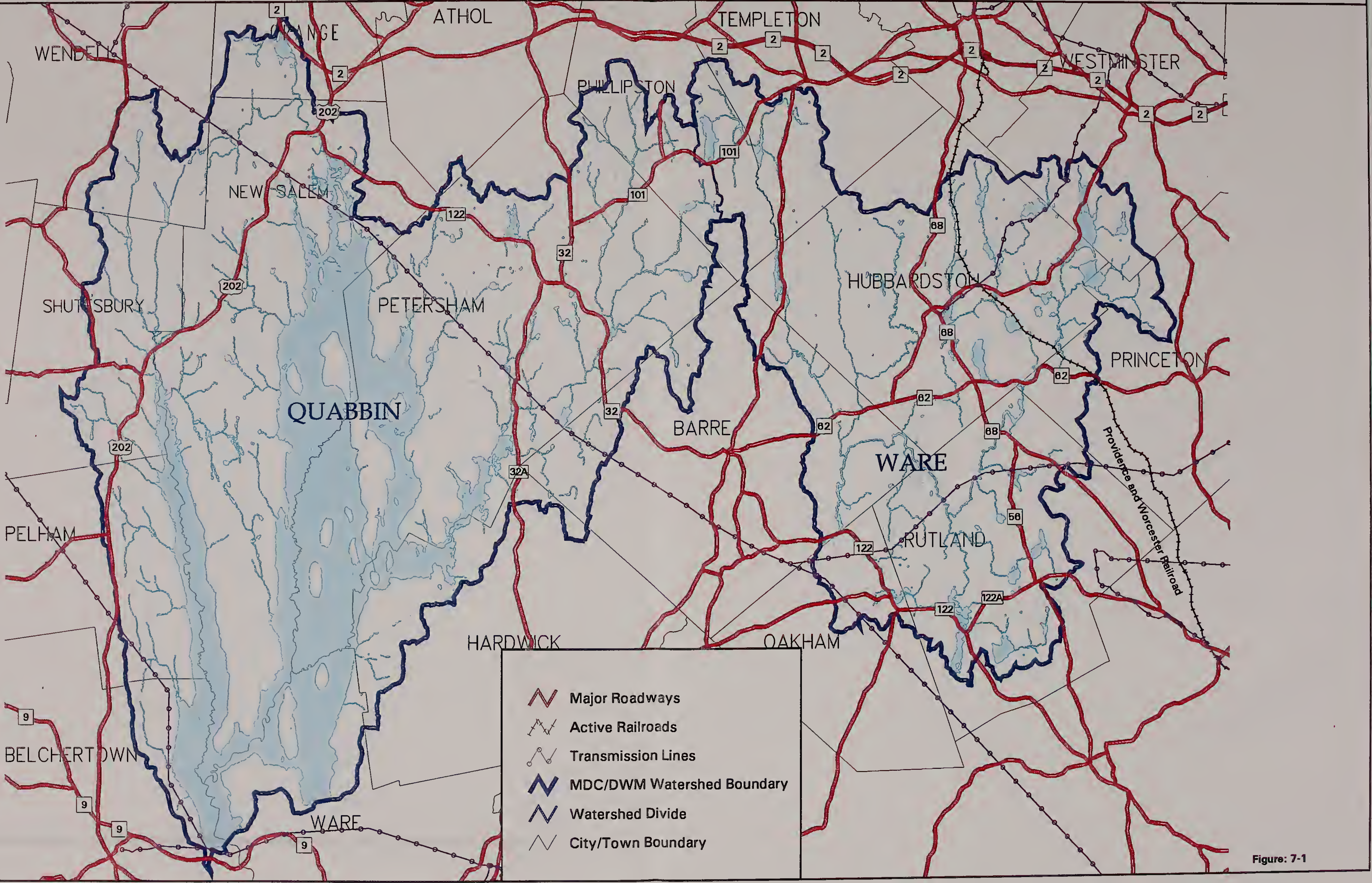
WENDELL
ORANGE
ATHOL
TEMPLETON
WESTMINSTER
PHILLIPSTON
NEW SALEM
SHUTESBURY
PETERSHAM
HUBBARDSTON
PRINCETON
QUABBIN
BARRE
WARE
PELHAM
RUTLAND
HARDWICK
OAKHAM
BELCHERTOWN
WARE
Providence and Worcester Railroad
2
202
101
122
32
32A
68
62
56
122A
9
Major Roadways
Active Railroads
Transmission Lines
MDC/DWM Watershed Boundary
Watershed Divide
City/Town Boundary

Figure: 7-1

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- Route 32A is characterized by its rural drainage system (e.g., lack of catch basins and grassed culverts). Since 1998, Division staff have worked with the local DPW to employ drainage modifications that increase dispersion through overland flow, and decrease direct discharge from paved waterways. In addition, projects have included guardrail upgrades (installed in areas crossing watershed tributaries) and access management (e.g., eliminating problem areas).

- Route 9 passes very close to the CVA intake. Division staff have reviewed preliminary plans submitted by the MHD and made comments to improve safe guards against possible hazardous waste spills.

- DWM staff made comments on 25% design plans for the Prescott Road rehabilitation project that address structural modifications at the intersection of Route 202. Structural modifications include a right-hand turning lane off Route 202, the extension of culvert headwalls, and the alteration of roadway drainage patterns. The project includes transportation safety at a major intersection and extensive water quality enhancements.

Table 7-2 summarizes highway BMP projects.

Table 7-2

Highway Drainage Issues and MDC/DWM Projects

Highway Segment	***Issue***	***Corrective Action/Project***
Route 122 Petersham, MA	Direct stormwater discharges	Evaluation of maintenance needs with implementation in coordination with MHD
Route 62 Barre, MA	Direct stormwater discharges	Evaluation of maintenance needs with implementation in coordination with MHD
Route 202 Shutesbury, MA	Direct stormwater discharges	Evaluation of maintenance needs with implementation in coordination with MHD
Route 32A Petersham, MA	Direct stormwater discharges, installation of guardrails near tributaries	Evaluation of maintenance needs with implementation in coordination with local DPW
Route 9 Belchertown, MA	Hazardous waste spills	Evaluation of preliminary plans in coordination with MHD

Source: (MDC/DWM Environmental Quality, 2000)

Transportation Release Controls Study

In the section on Uncontrolled Releases - Transportation, the 1991 Plan identified two actions that relate to general transportation issues:

- Reroute transport of hazardous waste and materials to less dangerous roads away from the reservoir.

- Develop agreements with transporters to have them submit summary reports on a yearly basis to the DWM, describing transportation activities.

DWM recently completed the Transportation Release Controls Study to fulfill these actions. The study was conducted by a consultant contract with Rizzo Associates and has performed the following tasks:

- Surveyed the watershed and assessed the risks of contamination from runoff, as well as potential transportation-related hazardous material spills.
- Reviewed the traffic patterns, structures, and operations of the roadways and railways to determine areas of concern, which are being inspected to develop a program of recommended improvements.
- Outlined procedures for DWM to obtain information from highway and railway operators, after surveying the railway's operations and manifest recording systems. In particular, obtaining information on the railway's hazardous materials shipments is important to DWM due to the restrictions Federal laws place on DWM's ability to regulate these shipments.

Railways

An action recommended by the 1991 Plan was to receive notification and participate in the review of YOPs filed by utility companies and railroads.

DWM's efforts have included:

- Implementing Rights-Of-Way (ROW) maintenance regulations. DWM staff have worked closely with DFA, New England Electric Services, and the Providence and Worcester Railroad Company on ROW treatments. DWM staff review the Vegetative Management Plans (VMPs) and the Yearly Operational Plans (YOPs) developed by the utility. The ROW corridor is inspected with the proponent and DFA staff, if available, to ensure that all resource areas are marked. Herbicide usage is reviewed, and the utility notifies DWM when treatment occurs. A post-treatment inspection is conducted by DWM, with a utility representative. Water quality samples may be collected at any time during the process, if deemed necessary by DWM.

Pesticides, Herbicides, and Fertilizers

Three actions discussed below were identified in the 1991 Plan associated with these applications.

- Support concept of proposed new DFA regulations designed to protect water supplies.
- Receive notification of major applications of pesticides and herbicides to agricultural operations and golf courses, roadside applications by local and state DPWs, and applications for the purpose of lawn care.
- Receive notification and participate in the review of Yearly Operating Plans (YOPs) filed by utility companies and railroads.

DWM staff has worked closely with the Massachusetts Department of Food and Agriculture (DFA), the agency responsible for administration of the pesticide regulations (333 CMR 1.00-11.00), to fulfill the above actions. DWM's efforts have included:

- DWM supported the enactment of DFA regulations in 1992 to protect water supplies and to require notification to water suppliers before applying pesticides or herbicides. Currently, revisions to these regulations are being proposed, and DWM has reviewed the draft regulations and submitted comments.

- DWM receives notification of applications of pesticides and herbicides informally and through the MEPA process.

- In 1997, DWM developed a Memorandum of Understanding (MOU) with DFA to clarify the relationship between DFA and MDC regulations, in particular with respect to the definition of water supply resource and the role of MDC WsPA maps in this definition, and to designate areas of concern for the railway applications. In addition, DWM has lobbied to improve the ROW regulations to create better setbacks near the reservoirs and tributaries.

Through the implementation of the Watershed Protection Act's permitting process, DWM has also been reviewing any new major applications of pesticides or herbicides within the Act's regulated zones.

Road Salt

The 1991 Plan included two MDC actions:

- Encourage low salt use on roads; and
- Monitor outdoor storage supplies of salt.

DWM staff continues to implement low salt use on through roads used by the public and maintained by the DWM in the Quabbin Reservoir and Ware River watersheds.

As a result of DWM's discussions with MHD, a preferred site has been identified to relocate an existing salt storage and maintenance facility sited next to Long Pond, in Rutland, MA. MHD is currently operating the facility on MDC-owned land under an agreement with the Commission. DWM staff has proposed many relocation options to MHD. MDC staff conducted an archeological investigation to assure that the site chosen as the preferred site did not contain significant historical remains. DWM's staff is currently reviewing the method of reassigning the care and control agreement between the MDC and MHD to the preferred site.

Emergency Response (for Hazardous Materials Release)

The 1991 Plan included one MDC action:

- Train local and Metropolitan Police to enforce regulations, such as the manifest reporting system, regarding transportation of hazardous waste and materials.

Comprehensive Environmental Inc. (CEI) completed an Emergency Response Plan (for Hazardous Materials Releases) in the Quabbin Reservoir and Ware River watersheds for DWM. CEI developed an inventory of all parties involved in response in the watersheds. The inventory includes existing response capability (personnel and equipment) and estimated response times. Meetings were held by MDC/DWM with all responders (e.g., State Police, watershed town officials, and DEP). A plan has been developed which will enable the MDC to help coordinate and enhance interagency and local response mechanisms. A copy of the Plan was sent to DEP DWS.

7.1.2 Assessment

In general, runoff from highways and railways is a moderate threat to water quality, though spill/ releases of hazardous materials (discussed in **Section 7.3**) are considered a high potential threat. The pollutants of greatest concern in runoff from highways/railways are heavy metals and petroleum products. Sediment loading is considered to be the next level of concern, and is often used in BMPs to indicate pollutant removal efficiency. The vegetative maintenance practices are also a concern because inappropriate application and/or handling of pesticides and herbicides is a risk to the water supply. Salt storage and application of salt to the roadways in the watersheds is also a potential threat which DWM staff are working to minimize. While highways and railways in the watershed are an obvious pollution threat, they are also a necessary part of the state infrastructure. With the completion of the Transportation Release Controls Study, DWM has a sound foundation to build the coordination and interactions necessary to address water quality concerns.

7.1.3 Control Approach

7.1.3.1 Goals

There are primarily three goals in DWM's program to protect the reservoir from pollutants associated with highways, railways, and utility right-of-ways:

- Make improvements in the safety of these corridors by structural and operational enhancements so that the threat from accidental releases is minimized.

- Improve existing drainage infrastructure so that pollutants that are discharged with stormwater to the reservoir or its tributaries are treated before discharge.

- Review and monitor VMPs and YOPs to protect sensitive water resource areas.

7.1.3.2 Five-Year Objectives

Over the next five years, DWM's objectives for highways, railways, and utility right-of-ways are:

1. Compile database on materials being transported through the watershed via roads and rails.

2. Establish a plan and implementation schedule to assess all direct highway and railway discharges to Quabbin Reservoir and Ware River intake.

3. Improve coordination with MHD and local DPWs to improve stormwater quality from highway drainage that discharges near the reservoir, intake, and watershed tributaries, through both structural and maintenance improvements, and incorporate water quality protection practices into new construction and improvement of existing roadways.

4. As part of Transportation Release Controls Study, complete prioritization of highway and railway-related operational and infrastructure protection efforts to recommend application of known technologies to specific sites.

5. Expand the DWM's knowledge of Federal Highway Administration (FHA) and Federal Railway Administration (FRA) regulations and limitations to assess rerouting options, implement and enforce operational changes, and improve working relationships between agencies.

7.1.3.3 Activities

General

1. Implement recommendations from the Transportation Release Controls Study, in coordination with MHD and other transportation entities (e.g., FHA, FRA, Executive Office of Transportation and Construction, and Regional Planning Commissions). Develop a program of recommended improvements after inspecting the areas of concern identified in the watersheds. The study recommendations will serve as a basis for developing a funding mechanism and a program of improvements, based on proximity to the intakes, traffic level, roadway/railway conditions and signage, and type and number of hazardous materials transported. The program will address: the process and need to reroute hazardous material transport; the need for structural controls for accident prevention such as reinforced guardrails; and opportunities to install stormwater controls, including redirection and treatment options.

2. Use MDC/DWM labor, as well as consultant and/or construction contracts, to complete specific improvement projects.

Highways

3. Coordinate with MHD and local DPWs to continue to implement highway BMPs along State highways and smaller roads within the watersheds.

4. Coordinate with DWM staff to implement BMPs on MDC maintained roads.

5. Continue to locate, map and assess untreated stormwater discharges from highways to tributaries in the watersheds.

6. Establish consultant contract to locate and map stormwater conveyance structures within the watersheds.

Railways

7. Establish consultant contract to determine and assess watershed management opportunities for the improvement of hazardous materials transportation practices via railway.

8. Continue to monitor YOP implementation for railroad rights-of-way maintenance by field verifying protection zones. Coordinate with DFA-PB, as necessary.

Items in Conjunction with Other Programs

9. Assess benefits of implementation of stormwater treatment cell technology to highway and railway discharges.

10. Establish contracts to refine hydrodynamic modeling of the Quabbin Reservoir and its watershed.

7.2 Individual Contaminated/Suspected Sites

Accomplishments:

- Landfills: Monitored closures and risk assessments, working with DEP/Solid Waste.
- Site inspections: Investigated all known contaminated sites and hazardous waste generators through coordination with DEP and the sanitary survey process.
- Began monitoring DEP's database of recorded hazardous materials release for investigations in 1997.

Assessment:

- Generally low threat to reservoir water quality; threats include heavy metals and petroleum products.

Key Activities:

- Existing programs: Continue site inspections through the sanitary survey process, monitoring of USTs, tank pulls, and landfill closures.
- Status reports: Develop for all recorded releases in the watersheds, outlining the actual threat of the incidents to the waters of the watersheds.
- Licensed Site Professionals (LSPs): Establish relationships to improve DWM's knowledge of clean-up activities in the watersheds.

7.2.1 Program to Date

7.2.1.1 History

Two types of sites typically fit into the Individual Contaminated/Suspected Sites category: 1) hazardous material release sites, and 2) landfill sites. Prior to 1991, DEP would informally notify DWM of spills or releases of hazardous materials to the environment (then called "21E" sites) within the watersheds. Often the DWM would gain knowledge well after the incident, or not at all.

During watershed sanitary inspections (a.k.a., sanitary surveys) (see **Section 8.3**), DWM would seek an update of the clean-up progress of specific 21E sites, and would research the DEP 21E files for sites within the subject sanitary district. Many sites were categorized as Listed Sites To Be Investigated (LTBI). Often very little information would be associated with these sites, making it difficult for the MDC/DWM (or DEP) to quantify or characterize any threats to the waters of the watershed. DEP copied and consulted MDC/DWM on landfill closures within the watersheds. DEP did not report any large releases in the Quabbin Reservoir or Ware River watersheds.

7.2.1.2 Current Program and Accomplishments

The following section discusses the specific actions taken in accordance to the 1991 Plan. Threats related to contaminated/suspected sites were ranked as "low potential" threat in the Quabbin Reservoir watershed and "low existing" threat in the Ware River watershed in the 1991 Plan. They continue to be ranked as "low" in the 2000 Plan Update. This section provides a discussion on the changes that have occurred since the 1991 Plan. In general, sites have been tracked, investigated, and monitored in coordination with DEP and municipal officials.

Underground Storage Tanks (USTs)

The 1991 Plan's recommended actions included inventory of Underground Storage Tanks (USTs), monitoring of tank pulls, and revisions to state regulations. UST removals are overseen by local fire departments and DWM receives notification if there are leaks or spills.

Landfills

The 1991 Plan's recommendations included coordinating with DEP to inspect and close landfills, and to prohibit new landfills and resource recovery facilities from Protection Zone A.

There are no open landfill sites in the Quabbin Reservoir or Ware River watersheds. Historic landfill sites in the watersheds are under two major designations: active and inactive. "Active" landfills refer to major municipal landfills that were required to be closed and capped under 310 CMR 19 (October 1990). "Inactive" landfills refer to municipal/local dumping areas that were abandoned prior to these regulations. Currently, the three "active" landfills in the Ware River watershed (Hubbardston, Rutland, and Princeton landfills) have been closed and capped. Post closure long-term monitoring programs are currently being prepared. In Hubbardston, landfill water testing is on-going to assure leaching material will be cleaned up. DEP/Solid Waste is now focusing on "inactive" landfill closures. DWM works with DEP's Bureau of Waste Site Cleanup Solid Waste to informally monitor these closures, providing comment and data if possible. DWM is currently aware of three small sites of older origin, one of which has been documented to be releasing heavy metals to the groundwater. Regardless of the status of the closed landfills, DWM monitors the water quality down gradient of water resources.

No new landfills are anticipated in Protection Zone A. The Watershed Protection Act of 1992 restricted land uses, including solid waste facilities, in zones 400 feet from the reservoir and 200 feet from tributaries or surface waters in the watersheds.

Uncontrolled Releases - Fixed Site

The 1991 Plan recommended: cleanup of 21E sites by the owners and DEP, notification of releases to DWM, and establishment of local hazardous materials bylaws.

A major change since 1991 was DEP's 1993 reorganization of the management of 21E sites through the "New Massachusetts Contingency Plan" (New MCP, 310 CMR 40.00). All sites listed with DEP prior to 1993 were evaluated, and those sites that were determined to be of valid concern ("transition" sites) were brought into the new system. Each transition site was given a deadline for complying with the requirements of the new MCP, according to the date the site was originally reported to DEP. All new sites are handled under the new system. Two such sites exist in the Ware River watershed. These sites are currently being monitored for regulatory compliance. There are no transition sites in the Quabbin Reservoir watershed.

The new MCP streamlined the process for cleaning up waste sites (formerly labeled 21E sites) through two major changes: 1) the creation of the Licensed Site Professional (LSP) role to oversee the remediations and report to DEP, and 2) the establishment of a "tier" classification system to regulate the level of DEP oversight. Only sites of major significance ("Tier 1") require direct DEP oversight. The new MCP also established reporting requirements for DEP, which include initial, tier classification, clean-up stage, and final information requirements on the site's cleanup. From the date of tier classification, the responsible party has four years to submit the final information or Response Action Outcome (RAO) for the site.

In 1997, the DEP Bureau of Waste Site Cleanup (DEP/WSC) at Central Regional Office and DWM generated a comprehensive database of all recorded releases of hazardous materials to the environment within the Wachusett Reservoir watershed. DWM receives a monthly copy of the Standard Release Report issued by DEP/WSC and updates this database. According to these records, since 1991 there have been 66 active sites in the Wachusett watershed where spill releases occurred and remediation was undertaken. Most of these sites are smaller, lower priority sites ("Tier 2"), and some have already been cleaned up. Only three sites in the watershed have required direct DEP oversight ("Tier 1"). Of these three, the Texaco site in West Boylston has been cleaned up, and only the Shell site in West Boylston and the Charter Gas site in Holden remain active.

DWM conveys information on suspected releases to DEP, that it uncovers through sources such as informants, watershed sanitary inspections, environmental site assessments performed for potential land acquisition, active and inactive landfill monitoring, etc. Also, if DWM believes an LSP or a responsible party is mishandling the clean-up of a site, these concerns are relayed to the DEP/WSC for review and action.

As new inspections are performed, known contamination sites are investigated and the threat of contamination of the waters of the watershed are evaluated in a status report filed under the specific site or the specific subbasin file. This report provides a brief history and status of the site and an estimate of the strength of the hydraulic and hydrologic connection from the source to the tributary or reservoir.

7.2.2 Assessment

These limited sources pose only a limited threat to water quality, but still require monitoring. USTs that are pulled are properly monitored through local fire departments and any spills/releases are notified to DWM. Landfills in the watersheds have all been closed, capped, and are monitored. The new Massachusetts Contingency Plan (MCP) has been adopted and has streamlined the cleanup of hazardous material release sites in the watersheds, which tend to be small and lower priority. There are very few hazardous waste generators in the watersheds.

7.2.3 Control Approach

7.2.3.1 Goals

DWM will continue evaluating release sites for their potential to adversely affect the watershed waters. If water quality is compromised, or there is a high priority threat, MDC/DWM will work swiftly with DEP to address the situation. In addition, DWM intends to continue with its ongoing programs to monitor UST tank pulls and landfill closures, and with its household hazardous waste collections.

7.2.3.2 Five-Year Objectives

In addition to continuing with existing programs, DWM plans to:

1. Develop a status report for all recorded releases of hazardous materials in the watershed, outlining the actual threat of the incident to the waters of the watershed.

2. Establish relationships with LSPs working in the watershed to keep up to date on all clean-up activities. These relationships will allow DWM to obtain more current information on the clean-up status of sites than it currently receives from DEP monthly reports.

As described in **Section 7.3**, DWM will also work to implement recommendations from the Emergency Response Study to reduce the potential of hazardous material spills from reaching the water supply.

7.2.3.3 Activities

MDC/DWM will meet the objectives through several on-going programs:

1. Monitor the DEP hazardous materials release database and follow up on sites.

2. Investigate contaminated sites and hazardous waste generators through coordination with DEP/WSC, and the sanitary survey process.

3. Monitor UST tank pulls in the watershed through cooperation with local fire department, and receiving notification of leaks and spills when they occur.

4. Monitor landfill closures and risk assessments through cooperation with DEP/Solid Waste.

5. Inventory residential and commercial USTs in the watersheds.

7.3 Emergency Planning and Response

Accomplishments:

- Hazardous Materials Emergency Response Study: Completed report, which made recommendations for changes in Emergency Response Plans for the watershed communities.
- Spill Response/Outside: Organized MDC's position within the communication system with state and local emergency responders; supported the purchase of response equipment for existing responders.
- DWM staff participated in "Weapons of Mass Destruction and Chemical, Ordinance, Biological, and Radiological (C.O.B.R.A.) Incident Command" training program held on site.
- Spill Response/In-House: Organized a rotating schedule to maintain DWM staff on call, through a beeper, to assist first response actions.

Assessment:

- Level of threat depends on the type and volume of product released and the location of the incident. The most critical areas are those that drain to the reservoir directly, which also have the highest volume of hazardous material transport in the watershed.

Key Activities:

- Hazardous Materials Emergency Response Study: Implement recommendations.
- Databases: Maintain databases of transportation-related releases and site releases.
- Spill Response/Outside Responders: Foster the appropriate training and equipping of local responders; coordinate a mock hazardous material release; coordinate with Massachusetts Emergency Management Agency (MEMA) to improve coordination of emergency response along watershed boundaries.
- Spill Response/In-House: Provide appropriate training for DWM staff; purchase and establish reservoir response units.
- Industries: Develop a mailing regarding the federal requirement for release notification and an Emergency Response Plan.

7.3.1 Program To Date

7.3.1.1 History

According to the 1991 Plan, the threat posed by hazardous materials spills/releases to water quality from either contaminated sites or transportation corridors was high in both watersheds. In this Plan Update, the threat posed by releases from contaminated sites has been revised to low, due to the small number of sites present in the watershed, their locations, and the fact that they are permitted and regularly inspected. However, the threat posed by releases from transportation corridors is still considered high potential, since there is significant transport of hazardous materials through these corridors and an accident could introduce these materials to reservoir or tributary waters.

This Plan Update includes separate sections on Highways, Railways, and Utility Rights-of-Ways (**Section 7.1**) and Individual Contaminated/Suspected Sites (**Section 7.2**), both including elements related to emergency prevention and cleanup. This section specifically addresses MDC/DWM's emergency response planning and response as a tool to minimize the threat of accidental spills/releases, particularly in the watersheds' transportation corridors.

Prior to the 1991 Plan, emergency response coordination between DWM and local emergency responders was not formally planned and DWM staff was not necessarily notified when an incident occurred. At that time, DWM activity was limited to documenting release incidents and corrective actions through the sanitary survey inspections.

7.3.1.2 Current Program and Accomplishments

The 1991 Plan stated under Uncontrolled Releases - Transportation:

- Reroute transport of hazardous waste and materials to less dangerous roads away from the reservoir.
- Develop an interagency emergency response plan and training;
- Train local and Metropolitan Police to enforce regulations, such as the manifest reporting system, regarding transportation of hazardous waste and materials;
- Develop agreements with transporters to have them submit summary reports on a yearly basis to the DWM describing transportation activities.
- Prevent trucks carrying oil or hazardous materials from using the road across Winsor Dam and the Shaft 12 access road; and
- Evaluate structural controls for the following locations:
  - Route 202 crossings of several tributaries,
  - Route 122 adjacent to the Quabbin Reservoir and Ware River, and
  - Route 32A crossing of several tributaries.

In addition, under Uncontrolled Releases-Fixed Site, the 1991 Plan stated that DWM should:

- Ensure immediate and complete cleanup of Chapter 21E sites as they occur;
- Receive immediate notification of all release; and
- Develop and implement model hazardous materials bylaws and regulations.

DWM's strategy to address the risk of hazardous material releases and affect appropriate response was directed toward aiding the municipal responders whose responsibility it is to protect the safety of their communities. DWM accomplished the following:

- Identified sources and generators of hazardous materials;
- Worked with the DEP Incident Response Team and local Hazardous Material Coordinators on spill response measures;
- Worked with DEP and MHD to identify critical highway and drainage system elements as part of a comprehensive emergency response system and to coordinate efforts to design and build appropriate drainage system improvements (see **Section 7.1**);
-

- Developed in-house emergency response and spill prevention measures; and

- Organized MDC's position within the system of communication with state and local emergency responders.

Hazardous Materials Emergency Response Study

MDC/DWM recently completed a consultant contract with Comprehensive Environmental Inc. (CEI) to review and prepare a Hazardous Materials Emergency Response Study which recommended changes to Emergency Response Plans for the watershed communities. CEI also advised DWM on the development of a comprehensive emergency response action plan for the entire watershed system. Included with the review of the current response equipment and training needs were recommendations to enhance response capabilities, and areas were identified where DWM could store response equipment and supplies to improve response times. Integral to the Emergency Response Study, CEI determined that a separate MDC-staffed response team would not give DWM substantial response improvements. CEI determined that the greatest benefits would be realized for DWM by improving the existing responders resources (i.e., local fire departments' equipment and training).

Spill Response - Outside

MDC/DWM has actively worked with MHD and municipal fire, police and highway officials to coordinate response actions for spills and releases in the watershed. DWM also coordinated with DEP to have a reciprocal agreement that all spill/release notifications are forwarded to the other agencies (about 10 notifications have occurred in the last 5 years), and DWM was involved in DEP's effort to purchase improved response equipment throughout the state. These equipment, including a Technical Operations Module, an Operation Response Unit, and an Operation Support Unit, are housed in Marlborough, Worcester, and Chelmsford, respectively.

Since the 1991 Plan, the Metropolitan Police unit has been incorporated into the State Police. The State Trooper currently on a watershed patrol has received training in hazardous material release response actions and the manifest reporting system.

Other Activities

Other DWM activities that have contributed to emergency spill control include:

- Detention basins - Built for roadway/railway drainage and storm water improvement, they provide a large storage volume for hazardous material containment if a spill occurs. (For information on other highway drainage projects, see **Section 7.1**.)

- Transportation Release Controls Study - Conducted through a consultant contract, the study assessed the risks of contamination from transportation-related hazardous material spills as well as from runoff (see **Section 7.1**).

7.3.2 Assessment

A general assessment of the threats present at the watersheds' sites or transportation corridors has been provided in **Sections 7.1 and 7.2**. A low threat is expected from contaminated/suspected sites, because only a small number of sites exist in the watershed, and these sites are currently permitted and regularly inspected. A high potential threat is expected from highways/railways accidental spills, because they could introduce chemicals or fuels directly into the Quabbin Reservoir or Ware River Intake. The following discussion expands on issues related to emergency planning and response, particularly for the highways/railways.

DWM prioritizes the level of the water quality threat presented by an accidental spill/release based on a number of factors. An accidental spill/release at a transportation corridor or a site in the watershed can introduce a range of chemicals, oils, and petroleum products to the reservoir or its tributaries. According to the recently completed Hazardous Materials Emergency Response Study, the pollutants associated with such incidents include: petroleum distillates, PHC, chemical carcinogens, and synthetic organics (e.g., pesticides, solvents, polynuclear aromatic hydrocarbons (PNAs), and polychlorobiphenols (PCBs)). The impact of the spill/release depends on the specific product that was released, the volume of product released and the location of the incident. The impact of a spill/release will be most critical in the Reservoir. **Figure 7-2** depicts estimated peak daily vehicle trips of hazardous materials cargo on roadways within the Quabbin Reservoir watershed and Ware River watershed. The peak daily traffic volumes vary between the watersheds with greater traffic volume in the Ware River watershed.

7.3.3 Control Approach

The risk of hazardous material releases depends on the materials present, the operating conditions, and spill/release containment plans. Methods to reduce the threat fall into three general categories: 1) materials relocation/reduction (change the location of hazardous materials storage/transport, replace products with more benign ones, reduce the volume of materials used/transported); 2) prevention (increase safety of operating conditions); and 3) containment (plan immediate and effective emergency response).

7.3.3.1 Goals

The goals of the emergency planning and response program encompass prompt effective response actions, as well as more general approaches such as: 1) reducing the volume of hazardous materials; and 2) improving existing mechanisms or installing practices that minimize pollutant loading to the reservoir. The implementation of these goals will take precedence on the watershed areas where spills pose the greatest threat to water quality.

7.3.3.2 Five-Year Objectives

Over the next five years, DWM's objectives for emergency planning are:

1. Monitor DEP's databases of generators and volumes of hazardous materials.

2. Coordinate with DEP and watershed businesses using hazardous materials to minimize quantity used/stored. Implement an education program with DEP and other existing programs to teach the generators and others that their actions have environmental implications, both locally and regionally.

3. Establish budget and staff within DWM to complete the efforts outlined in the Hazardous Materials Emergency Response Study.

4. Ensure local responders have appropriate training and equipment.

5. Investigate the options to change the routes of hazardous materials carriers, both roadway and railway, to circumvent the watershed or to routes that pose the least threat.

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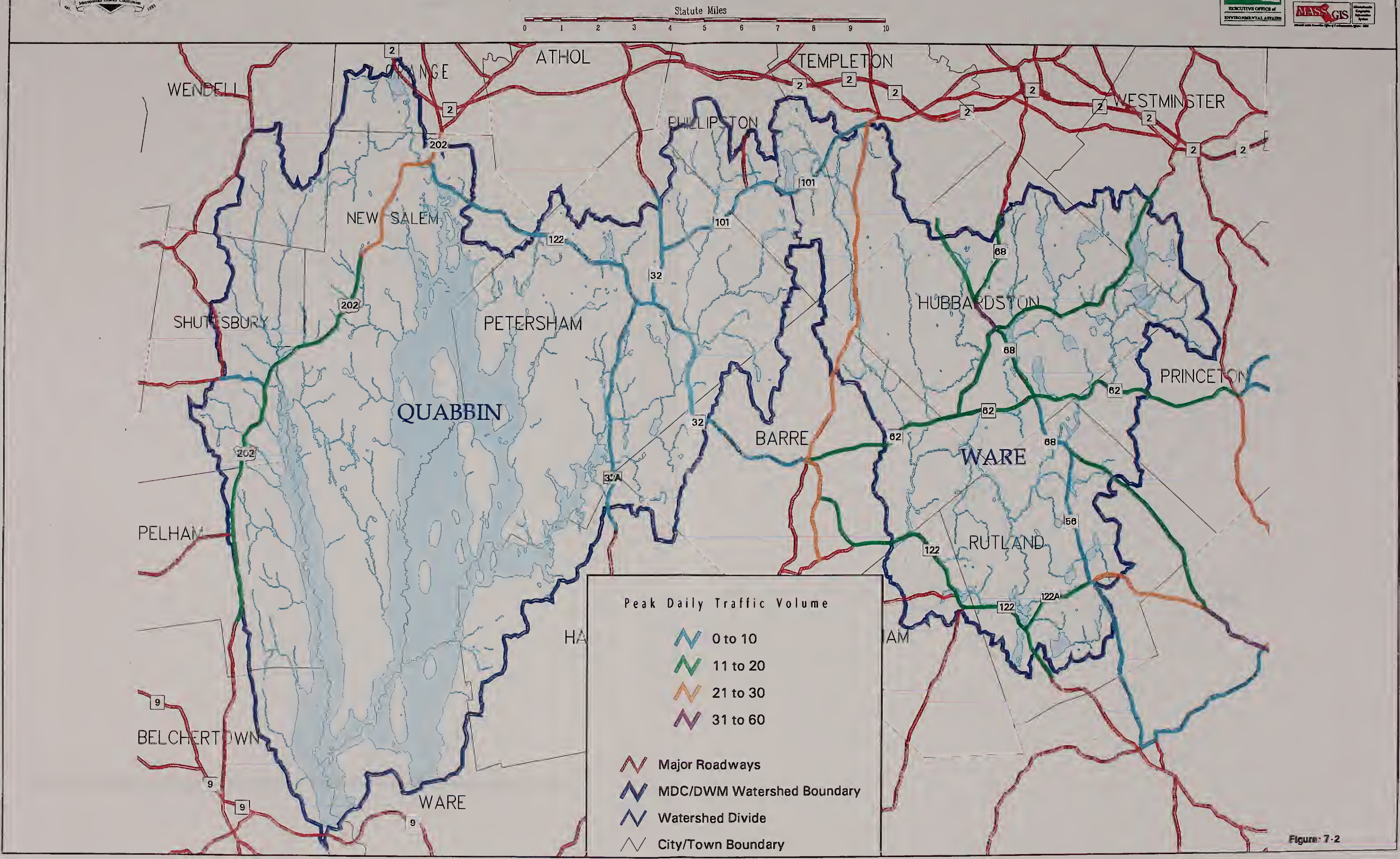
Hazardous Materials
Daily Traffic Volumes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PHILLIPSTON
NEW SALEM
SHUTESBURY
PETERSHAM
HUBBARDSTON
PRINCETON
QUABBIN
BARRE
WARE
RUTLAND
PELHAM
BELCHERTOWN
WARE
HA
AM
2
202
122
101
32
32A
68
62
56
122A
9
Peak Daily Traffic Volume
0 to 10
11 to 20
21 to 30
31 to 60
Major Roadways
MDC/DWM Watershed Boundary
Watershed Divide
City/Town Boundary

Figure 7-2

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7.3.3.3 Activities

Hazardous Materials Data and Reduction

1. Contact appropriate Federal and State agencies to compile a database of the types and quantities of hazardous materials transported through the watershed.

2. Determine the appropriate paths of communication with Federal and State agencies to reroute hazardous materials from highways and railways in the watershed, and coordinate with the appropriate authorities to assess rerouting of hazardous materials transported by highway and railway in the watershed.

3. Maintain DWM's databases to establish locations of hazardous material generators in the watershed.

4. Request Federal Toxic Chemical Release Inventory forms.

5. Coordinate with DEP to enhance the source reduction efforts in the watershed. Determine if DWM could improve the current efforts in the watershed to reduce the need and the use of hazardous materials by industries in the watershed.

Emergency Response Planning

6. Develop a mailing to industries regarding the Federal requirements to notify of a release and to have an Emergency Response Plan under the US Superfund Amendments and Reauthorization Act (SARA) Title III.

7. Contact MEMA to improve the template used to update each community's emergency response plans by adding an additional template to document current equipment and notification information.

8. Advocate to MEMA for the regionalization of the emergency planning committees to occur along watershed boundaries.

9. Coordinate Emergency Response Plan with MWRA.

Highways/Railways

10. Coordinate with MHD to erect signs to note entry into the Quabbin Reservoir watershed and Ware River watershed, as drinking water supply watersheds.

11. Monitor inspection frequency of rails along no-spray and limited spray zones.

Training

12. Encourage all fire departments to receive the ‘operations level’ and ‘incident command’ training.

13. Encourage all watershed police departments to receive the ‘awareness level’ training.

14. Investigate the development of a grant program to the watershed communities to afford the appropriate training to the fire and police departments.

15. Encourage DWM staff to attend incident command system (ICS) training conducted by MWRA.

16. Contact training professionals to conduct ‘awareness level’ training for appropriate DWM staff.

17. Coordinate with other state agencies to conduct a mock hazardous materials release on the roadways/railways to assess the adequacy of the response system.

Response Equipment

18. Ensure that each watershed community has adequate equipment to respond to an anticipated hazardous material release.

19. Establish the reservoir response units and equip them to contain releases into the reservoir.

7.4 Construction Sites

Accomplishments:

- Local Boards: Attended meetings, reviewed proposals, and trained board members.
- Regulations: Completed a review of erosion control bylaws, and recommended where improved bylaws could be adopted; incorporated erosion control into the MDC/DWM's Model Subdivision regulations, and commented on revisions to MEPA regulations by EOEA.
- Watershed Protection Act (WsPA): Obtained the highest degree of protection in the zones set forth in the Act using state-of-the-art construction techniques and erosion controls.
- Field inspections: Conducted field inspections of construction sites under DWM jurisdiction and/or in response to request from local party.
- Training: DWM staff received training on advanced erosion control techniques.
- Developed the *MDC/DWM Erosion and Sedimentation Control Manual* in 1995.

Assessment:

- Construction site runoff is overall a low priority threat; such sites can contribute sediment and nutrients to tributaries.

Key Activities:

- Continue to work with local boards, enforcing regulations and the WsPA, and monitoring construction sites.

7.4.1 Program to Date

7.4.1.1 History

The 1991 Plan listed improperly conducted construction activities as a potential source of sediment to surface waters. This threat was identified as a low potential threat in the Quabbin Reservoir watershed, a medium existing threat in the Ware River watershed, and a high potential threat in the Wachusett Reservoir watershed.

Prior to development of the Plan, DWM staff worked to reduce erosion potential from development. First, staff members were involved in local development review to give input to proper sedimentation and erosion control planning for proposed work. Secondly, staff maintained a presence in the watershed through routine testing efforts, sanitary survey inspections, routine inspection of permitted developments, and general surveillance, allowing DWM to identify construction site problems and work in conjunction with local authorities for enforcement.

7.4.1.2 Current Program and Accomplishments

The 1991 WPP listed three proposed actions to address the threat of construction activities in the Ware River and Quabbin Reservoir watersheds:

- Increase local enforcement and regulation of ongoing construction with respect to zoning, subdivision control, and permit conditions.

- Develop and implement model erosion control bylaws.

- Amend MEPA regulations to increase MEPA oversight of major development projects.

Since the completion of the 1991 Plan, two new tools evolved which give DWM an increased ability to control development impacts. The primary new tool was the passage of the Watershed Protection Act (WsPA) in 1992 and the subsequent adoption of Watershed Protection regulations by DWM (see **Section 5.1**). The Act limits development in close proximity to tributaries and thus, provides protection for areas adjacent to critical areas. Secondly, the Act provides for DWM review of proposed projects within regulated areas. While DWM has had much success working with local boards in development review and continues to do so, the Act allows staff a more thorough review of many projects, which in turn allowed staff to be more vigilant about erosion control efforts. Another tool MDC/DWM developed during the implementation of the Plan was DWM's increased land acquisition. The purchase of numerous acres of sensitive watershed lands removed them from potential development, thereby reducing possible impacts from construction erosion.

Currently, DWM's oversight of construction sites consists of the following three actions:

1) Work with local boards, including reviewing and commenting on proposals and training of board members;
2) Use the WsPA and Watershed Protection regulations (350 CMR 11.00); and
3) Conduct field inspections of construction sites under DWM's jurisdiction and/or in response to request from a local party.

Another success in DWM's ability to control erosion in the watersheds is an improved working relationship with MHD. This has allowed DWM to have some input on roadway reconstruction projects in the watersheds, thereby improving erosion control during construction and improving, in many locations, impacts from stormwater (see also **Section 7.1**).

Overall, DWM's strong presence in the watersheds has lead to detailed review of proposed developments and on-going oversight monitoring efforts during construction to limit erosion control impacts.

Local Boards

DWM staff have historically had some involvement with local boards responsible for enforcing local regulations. This activity has become more formalized over the last few years. Quabbin Section Environmental Quality and Planning staff are assigned as contact persons for major Planning Boards, Conservative Commissions, and Boards of Health. The staff attends board meetings, providing technical expertise often in the form of recommendations on projects and specific permit conditions. In addition, DWM sponsored and participated in numerous training sessions with boards in the watershed communities to further expand their knowledge of construction and related protection activities (see **Section 5.3**).

DWM's ongoing technical assistance work with Planning Boards, Conservation Commissions, and Boards of Health, in the watershed communities is a major contributor to effective control of construction sites. Staff have developed working relationships with the local communities and, in most cases, are closely involved in review of development projects, including individual residences as well as subdivisions. This allows staff to provide input on proper erosion and sediment controls necessary to protect downstream resources during construction. While construction is underway, staff periodically inspect construction sites to assure that plans are being followed and that water resources are adequately protected. DWM works to provide assistance in problem areas, either directly to project proponents or through the local boards.

Over time, DWM has developed relationships with many of the local developers and engineers and building inspectors. Project proponents now routinely meet with staff during the project planning stages to solicit input from DWM as to how a project can be best developed, keeping in mind protection of the water supply. This allows staff to aid applicants in putting forth a comprehensive sediment and erosion control plan for use, not only in review by the DWM, but with the local communities as well. In addition, even on projects not within DWM's specific jurisdiction, applicants know that DWM is an active participant in the local review process, often making applicants more responsive to DWM.

In addition to project reviews, DWM has been active in providing direct training to the local communities or in sponsoring other training opportunities through other agencies (see **Section 5.3**). DWM staff work to keep up to date on changing construction and erosion control techniques to provide the communities and project proponents with more and better alternatives for proper site control during and after construction.

Bylaws

In 1993, DWM completed a review of local bylaws in the watersheds, which included a summary of which bylaws existed in each community and where improved bylaws could be adopted, including a Model Soil Erosion and Sediment Control Bylaw. Some discussions with local communities followed, but none of the towns followed with implementation. In addition to the model bylaw, erosion control regulations were incorporated into the MDC/DWM's model Subdivision Regulations completed in 1998. These have been implemented in West Boylston and implementation will be encouraged in the other watershed communities.

In addition, MDC/DWM worked closely with MEPA staff over the last few years. The outcome of this relationship is that MEPA staff are very aware of the presence of the water supply in this area and rely heavily on DWM for input in decision making for projects in MDC/DWM watersheds. MWRA also comments to MEPA on projects proposed in the watersheds. MEPA staff revised the MEPA regulations, effective July 1, 1998 with MDC/DWM input.

Watershed Protection Regulations and the Watershed Protection Act (WsPA)

Under the Watershed Protection regulations (**see Section 5.1**), construction activities involved in altering land in the watersheds are specifically required to install adequate provisions to prevent erosion and the resulting siltation of waters in the watershed system. Further, under the WsPA, DWM has direct authority over projects proposed within the two zones set forth in the Act. In the Primary Protection Zone, the Act prohibits many construction activities within 200 feet of a tributary or surface water draining to the Quabbin Reservoir or the Ware River intake. This authority has allowed the DWM to have increased control over construction activities in the most critical land areas of the watersheds, those areas closest to water resources. In these areas, staff have been extremely successful in obtaining the highest degree of protection through the use of state-of-the-art construction techniques and erosion controls.

7.4.2 Assessment

The threat from construction sites is the potential for increased sedimentation to wetlands and tributaries to the drinking water supply. Sedimentation can impair the ability of these resources, such as wetlands performing the natural pollution attenuation functions they serve. In addition, sediment can transport other contaminants such as pathogens, nutrients, metals, and oil and grease.

Currently DWM is involved in reviewing development proposals on two levels: 1) applications under the WsPA, and 2) review through local boards of all other development proposals in the watersheds. Under WsPA, DWM has direct review responsibilities of development in the most environmentally sensitive areas (i.e., projects within the WsPA buffer zones). Between 1997-1999, DWM reviewed 243 WsPA applications in the Quabbin Reservoir and Ware River watersheds. Of these applications, 73 (30%) were for construction of single family residences, 8 were for residential subdivisions of 4 or fewer lots, 6 were for new commercial construction, and 1 was for a subdivision of 5 or greater lots. In 1996, a similar number of applications were reviewed. There were 144 decisions rendered with similar breakdowns in the types of activities being proposed.

DWM also reviews proposed activities that fall outside of specific WsPA jurisdiction according to the Watershed Protection regulations. It should be noted that these sites, because they fall outside WsPA buffers, are usually more remote from sensitive water supply resources, but still warrant attention because they are within the watersheds. These projects range from single family home construction to larger residential subdivisions. New commercial activities were limited to small projects and expansions of existing facilities.

Staff effectively use MDC/DWM regulations in combination with Federal, State, and local regulations to provide controls over construction activities. The various controls are effective in reducing erosion from these sites, based upon the very low turbidity throughout the tributaries.

7.4.3 Control Approach

7.4.3.1 Goals

The goal for construction sites is to limit the transport of pollutants from construction activities to tributary waters of the reservoir. The pollutant concern is the transport of silt in stormwater from the site, either through overland flow or to drainage systems, which then carry the sediment to the receiving waters. DWM's role is to identify and monitor construction activities in the watersheds. MDC/DWM, with DEP and/or local boards, will stop work in construction sites causing an immediate threat to water quality. DWM should work in the project development and review stage to assure that proper planning is used to identify and implement necessary controls to limit the flow of sediment-laden waters off construction sites.

7.4.3.2 Five-Year Objectives

Over the next five years, DWM's objectives for construction sites are:

1. Continue review of WsPA applications with a focus on implementation of appropriate construction site controls.

2. Work with other agencies and watershed communities tasked with the job of controlling erosion from construction activities.

3. Provide technical assistance to communities wishing to strengthen local bylaws and regulations to incorporate better erosion control methods.

4. Continue to expand training opportunities for local boards to gain knowledge of erosion control and construction Best Management Practices (BMPs) to limit erosion and the impacts of sedimentation.

7.4.3.3 Activities

DWM has a strong and effective program to identify, monitor, and remediate if necessary, erosion and runoff from construction sites. DWM must continue these efforts to oversee proper planning and implementation of erosion controls and to limit threats from construction activities to the drinking water supply. DWM's efforts in numerous programs overlap providing a well-developed approach to address erosion impacts from development. The management of construction site impacts falls into the following programs:

Community Technical Assistance (Section 5.3)

1. Work with local boards in review of development projects.
2. Continue to monitor development projects during construction.
3. Work with DEP on effective implementation of the Rivers Protection Act and the Stormwater Management Policy in the watershed communities.
4. Expand technical assistance to provide education and training to Planning Boards, Conservation Commissions, Boards of Health, and Building Inspectors on erosion controls and use of construction BMPs.

Watershed Protection Regulations and Watershed Protection Act (Section 5.1)

5. Implement the Watershed Protection regulations
6. Use the WsPA to review proposals.

Land Acquisition (Section 4.1)

7. Continue acquisition of sensitive watershed lands.
8. Maintain DWM lands to limit erosion, and consider installation of BMPs to control erosion and stormwater where needed.

Highways, Railways, and Utility Rights-of-Way (Section 7.1)

9. Continue and expand efforts to work with MHD on roadway projects.
10. Continue efforts to review and monitor railway and utility rights-of-way.

7.5 MDC/DWM Infrastructure Inspection and Maintenance

Accomplishments:

- Conducted regular and systematic inspections and maintenance activities of the Winsor Dam, its spillway, the Goodnough Dike, and MDC/DWM owned bridges and small dams.
- Provided year round maintenance of MDC/DWM buildings in the watersheds of the Quabbin Reservoir and Ware River.
- Inspected and maintains an extensive motorized fleet of trucks, boats, and equipment.
- Operated a limited fishing program with three boat launch areas for six months/year.
- MWRA operated and maintained the Chicopee Valley Aqueduct intake structure, Shaft 12 intake structure, and the Ware River intake structure.

Assessment:

- Comprehensive watershed protection activities conducted over 100,00 acres of land and water require significant infrastructure operation and maintenance activities by DWM staff in the Quabbin Reservoir and Ware River watersheds.

Key Activities:

- Conduct monthly infrastructure inspections (daily during flood watch), issue findings, and conduct maintenance activities as needed.
- Continue building and equipment maintenance activities.
- Operate the fishing program according to legal requirements and restrictions.

7.5.1Program To Date

7.5.1.1 History

MDC/DWM has a long history of inspection, maintenance, and improvement activities of its diverse infrastructure through bridge, dam and dike inspections; building and equipment maintenance, property boundary and fire line monitoring; and gate/barway installation and road system maintenance. While neither the 1991 Plan nor the 1998 Update specifically addressed these activities, this new section addresses infrastructure inspection, and maintenance activities conducted on MDC/DWM managed lands by a variety of DWM staff to protect water quality through site-specific controls.

7.5.1.2 Current Program and Accomplishments

Winsor Dam, Spillway, Goodnough Dike, MDC/DWM Bridge and Small Dam Inspections and Maintenance

DWM staff conduct daily, weekly, or monthly inspections of the Winsor Dam, its spillway, the Goodnough Dike, and MDC/DWM bridges, depending on the current status. Since 1991, DWM staff conduct monthly piezometer readings and visual inspections of the Winsor Dam and spillway structures. During flood watches, staff conduct daily inspections of the Dam and its spillway. Daily readings and systematic inspections (checklist available) were conducted between 1994-1995 on the Goodnough Dike during construction activities. Monthly inspections, including peizometer readings were resumed in 1996 and continue to date. DWM staff conduct yearly inspections of DWM bridges under use. In 1991, staff inventoried and inspected a total of seven bridges in the Quabbin Reservoir and Ware River watershed (excluding ACOE and MWRA managed bridges). DWM staff inspect and monitor small dams in the two watersheds. In 1991, staff inspected 24 small dams in the Ware River watershed and 7 small dams in the Quabbin Reservoir watershed. In 1999, staff inspected 15 functioning dams in the Ware River watershed. Between 1991 and 1998 several dams were discontinued in the Ware River watershed. All inspections are documented by reports issued by the Civil Engineers to the Superintendent and the MDC Engineering Group in Boston.

MDC/DWM Building Maintenance

DWM staff maintain six buildings, including associated septic systems and drinking water supplies, in the Quabbin Reservoir watershed for office locations. In the Ware River watershed, the MDC/DWM currently maintains one office building.

Maintenance of Trucks, Boats, and Equipment

Regular maintenance and repair of the Division's motorized fleet (cars, trucks, boat motors, etc.) and motorized equipment (e.g., chain saws, etc.) supports the DWM's diverse watershed protection activities.

Operation of Fishing Program

Shore fishing was first permitted when the Quabbin Reservoir opened to the public in 1946. The boat fishing program was introduced in the early 1950s at the request of the Governor. MDC has operated the fishing program with environmental quality as its primary concern to minimize impacts on water quality. Recent changes in federal laws governing public water supplies have placed greater attention on recreational activities. The Division publishes a Fishing Guide, annually, which describes all current prohibitions and limitations. Some of the restrictions include a six month season during which the program operates (April – October), daily hours of access, restricted areas for boat fishing on the Reservoir, boat size limits, occupancy limits, outboard motor size limits, bait restrictions, etc. For more information, see the Division's web page at www.state.ma.us/mdc/quabfish.htm.

MWRA Intake Structures

The Massachusetts Water Resources Authority (MWRA) operates and maintains two intake structures in the Quabbin Reservoir watershed. The Chicopee Valley Aqueduct intake structure is located in the southern end of the Quabbin Reservoir, below the Winsor Dam. The second structure, Shaft 12 Intake structure, is located in the northeasterly portion of the Quabbin Reservoir. MWRA also operates and maintains the Ware River intake structure in Barre, Massachusetts.

Other Activities

Other DWM activities that contributed to infrastructure operation and maintenance include:

- Quabbin Park Cemetery Maintenance:
  By 1940, MDC had removed approximately 7,543 bodies from lands purchased or released in the Quabbin Reservoir watershed; an estimated 95 bodies remained (MDC, 1940). Cemetery plots are maintained full time by several DWM staff off-watershed at the Quabbin Cemetery.

- Mowing and Snowplowing:
  DWM staff conduct mowing activities primary on the dam and dike structures as well as within the Quabbin Park and around administration buildings. Staff also maintains DWM roads by plowing activities for both staff and visitor access.

- Sign Construction and Installation:
  DWM staff maintain, install, and replace, a wide range of information signage at entrance locations, and within DWM lands.

7.5.2 Assessment

The DWM's extensive infrastructure network is effectively managed and improved by DWM's varied staff.

7.5.3 Control Approach

7.5.3.1 Goals

The primary goal of DWM's infrastructure inspection and maintenance activities is long-term water quality protection. The implementation of this goal is a foundation of all watershed protection activities by a water supply agency.

7.5.3.2 Five-year Objectives

Over the next five years, DWM's objectives for infrastructure inspection and maintenance activities are:

1. Support infrastructure inspections and maintenance activities necessary for watershed protection activities.

2. Continue operation of the fishing program according to state and federal regulations.

7.5.3.3 Activities

Winsor Dam and Spillway, Goodnough Dike, MDC/DWM Bridge and Small Dam Inspections and Maintenance

1. Conduct monthly inspections and issue findings.

2. Implement maintenance activities as needed.

MDC/DWM Building Maintenance

3. Continue building maintenance activities including well replacement and septic system monitoring.

Maintenance of Trucks, Boats, and Equipment

4. Conduct truck, boat, and equipment inspections and maintenance as needed.

Operation of Fishing Program

5. Continue the safe and legal operation of the boat and shoreline fishing program.

Section 8
Monitoring Programs

To meet regulatory needs and to measure the effectiveness of watershed management programs on drinking water quality, DWM implemented monitoring programs. This section describes the regulatory need for water quality and flow monitoring programs, accomplishments and goals of the programs, and watershed sanitary surveys conducted throughout the watersheds.

Section 8.1 describes the objectives of the water quality monitoring programs, including the locations and parameters monitored. **Section 8.2** summarizes the locations and methods of flow monitoring throughout the watershed, and describes how MDC/DWM is working to better understand watershed-reservoir hydrodynamics. **Section 8.3** describes the regulatory need for watershed sanitary surveys, and how they help to improve and maintain drinking water quality within the watersheds.

8.1 Water Quality Monitoring

Accomplishments:

- Implemented extensive routine water quality monitoring, analysis, and reporting for many years by MWRA and DWM at reservoir and watershed (tributary) sites in accordance with current regulatory requirements.
- Implemented routine pathogen monitoring program throughout the watersheds and reservoir.
- Conducted nutrient sampling and analysis of Quabbin Reservoir waters.
- Collected non-routine samples to document and support watershed management activities including enforcement actions for events such as failed septic systems, illegal discharges, hazardous materials spills, and runoff from construction sites, agricultural sites, and recreational areas.
- Initiated nutrient-algae study to collect information on algal dynamics in the reservoir.
- Characterized natural organic matter (NOM) in Quabbin Reservoir and quantified NOM fate and transport in the reservoir's basin.
- Since 1998, supplemented sampling program with biomonitoring to better understand fluctuations in water quality.
- Developed special studies to investigate, document, or remediate specific water quality issues throughout the watersheds, including studies identifying sources and transport of fecal coliform in the watersheds.
- Established a working relationship between DWM and MWRA to achieve lower detection limits for nutrient analysis.
- Developed and maintains an extensive database of water quality parameters measured in the various monitoring programs.
- Developed and calibrated a mathematical water quality model of Quabbin Reservoir for simulating coliform transport.
- Implemented watershed patrols and inspections of high risk areas including the reservoir shorelines.

Key Activities:

- Continue routine and non-routine water quality sampling and pathogen, algae, and biological monitoring throughout the reservoir and watersheds.
- Continue database management, data analysis, modeling, and reporting.
- Continue studies of nutrient-algal relationships throughout the watersheds.
- Continue weekly patrols and inspections.

DWM's mission and long-term goals require monitoring the water quality of tributaries and reservoirs within the watershed system. Water quality sampling and trend analysis help identify sub-basins and/or tributaries with contamination or degradation problems and, in turn, aid in the effective development and implementation of focused watershed protection efforts. Water quality data are also important to better understand the responses of the reservoirs and tributaries to a variety of physical, chemical, and biological inputs over time.

The objectives of monitoring are to:

1. Meet source water monitoring requirements of drinking water regulations and verify compliance with applicable source water standards (e.g., the fecal coliform and turbidity standards for unfiltered source waters).
2. Track the overall health of the system and detect any long-term trends that influence monitoring of water quality.
3. Verify compliance of tributaries with the state's surface water quality standards.
4. Aid in identifying and characterizing pollution sources.
5. Assess the effectiveness of watershed management measures.

8.1.1 History

For nearly 100 years, MDC and its predecessors have conducted water quality sampling throughout the Wachusett Reservoir, Ware River, and Quabbin Reservoir watersheds. Since 1938, EQ staff has conducted sampling and analysis at the DWM Quabbin laboratories in Belchertown. Over the years, the number and location of stations sampled has varied, as has the sampling frequency and the parameters measured. The MDC/DWM Quabbin laboratory is a DEP certified laboratory.

DWM has modified the sampling program periodically to meet changing priorities and public health concerns, as well as to incorporate newly developed analytical methods and updated regulatory requirements. This section discusses the monitoring conducted historically and in the recent past. The current monitoring program is outlined in **Sections 8.1.2 to 8.1.6**.

Regulatory Source Water Monitoring – Surface Water Treatment Rule (SWTR)

The Federal Surface Water Treatment Rule (SWTR) requires systems holding or seeking a waiver from filtration requirements to collect and submit source water quality data (turbidity and total or fecal coliform) demonstrating compliance with specified limits. MWRA is responsible for monitoring specific water quality data as required by drinking water regulations, as well as any other intake data desired for process quality control. These samples have historically been collected from the Cosgrove Intake at Wachusett Reservoir at the reservoir surface and at various depths. Samples are also collected from the Chicopee Valley Aqueduct (CVA) inside the Winsor Power Station at the Quabbin Reservoir as well as throughout the distribution system. DWM staff also collect fecal coliform samples at the Cosgrove Intake and from the CVA as part of the routine sampling program described below.

Routine Monitoring

At the Quabbin Section, historical sampling has included reservoir and tributary sites in both watersheds. Currently, five sites in the Quabbin Reservoir are sampled regularly, except when the reservoir is covered with ice; one site, Shaft 11A, is sampled on an intermittent basis (e.g., during Ware River transfers). Since 1941, water samples have been collected and total and fecal coliform, turbidity, pH, and alkalinity measured. In addition, temperature and dissolved oxygen are measured through the water column at meter intervals at each site. Since 1998, algal samples are collected from up to six depths to monitor for potential taste and odor from certain algae genera. DWM staff also routinely collects grab samples from 31 sites along twenty streams and seven ponds located in the two watersheds. Sample collection is conducted year round regardless of weather conditions. Parameters measured include total and fecal coliform, conductivity, temperature, dissolved oxygen, pH, alkalinity, and turbidity. Selected nutrients and metals, hardness, color, and chlorides are measured quarterly from samples taken from both the reservoir and watershed stations.

Special Studies

Additional samples are collected as part of special studies attempting to locate, document, and eliminate water quality threats. These have included:

- Investigations of agricultural sites;
- A study of mercury in the water column and in the sediment of Quabbin and Wachusett Reservoirs;
- Studies of algal population dynamics and the cause of periodic taste and odor problems;
- Continuation of a study to characterize natural organic matter inputs;
- Seasonal sampling and analysis during the gull control and deer control programs;
- Sampling and analysis of MDC/DWM Administration building's water distribution system;
- Various stream surveys at sites with elevated fecal counts;
- Daily monitoring during 1996 during the Copper Sulfate Application Study at the Quabbin Reservoir;
- A study of contaminant transport modeling in the Quabbin Reservoir;
- The development of methods to differentiate microorganisms sources in MDC/DWM watersheds;
- Plane crash study for volatile organic compounds (VOCs); and
- Occasional sampling of all major tributaries for metals.

These studies were accomplished independently by DWM or in conjunction with other state agencies, academic institutions, or consultants. Many of the results have been published and are available for review.

Biomonitoring

Streams are dynamic environments, constantly changing in response to a multitude of both interrelated and independent factors. The most common method of monitoring the health of these environments is the collection of grab samples, effectively providing a static "snapshot" of a rapidly changing system. Continuous sampling techniques are available for some parameters, but are expensive, unwieldy, or unnecessary. Thus, while the routine monitoring program is properly based on grab samples, DWM has supplemented its sampling program since 1988 with biomonitoring to better understand fluctuations in water quality.

Biotic communities integrate the effects of short-term environmental stresses and, therefore, reflect impacts of intermittent or low-level pollution events or contamination by an unexpected parameter that could be missed by routine sampling programs. A biomonitoring program compares biotic communities at different stream sites and then uses numerical measurements (metrics) to calculate the degree of site impairment. DWM uses aquatic macroinvertebrates to determine the degree of site impairment because they are easy and inexpensive to sample, relatively easy to identify, abundant in most streams, and indicative of localized conditions as a result of their sessile nature. Aquatic macroinvertebrate samples were collected from the Quabbin Reservoir and Ware River watersheds in 1988, 1989, and 1990 (See **Section 2.4.6**).

Samples and sampling stations in the Wachusett Reservoir, Ware River, and Quabbin Reservoir watersheds were compared with these reference stations to determine if macroinvertebrate populations were impacted and if these impacts were the result of pollutants or simply habitat characteristics. Results of the biomonitoring analyses were included in annual water quality reports. DWM has found the macroinvertebrate analyses to be an increasingly important part of ongoing water quality trend analysis and the Division's monitoring programs.

Brown's Hill Tributary Inspection

A routine sampling run in September 1996 indicated an elevated fecal coliform level in Brown's Hill tributary. DWM staff conducted weekly sampling for thirteen weeks along this tributary to the Middle Branch of the Swift River. A total of seventy-nine samples from nine sample sites were collected

The analysis showed an impact to water quality in streams downgradient of a ten acre cattle pasture where fecal coliform levels ranged from 100 to 30,000 colonies/mL. These results indicated that a ten acre cattle pasture was the pollution source. Agricultural best management practices were installed on site.

Pathogens

Pathogen sampling has become an important part of water quality monitoring, following the increased concern for these disease-causing agents throughout the drinking water industry. DWM began collecting pathogen samples in 1994. For the first few years, DWM collected samples at the reservoir and at suspected sites (e.g., downstream of potential sources, such as wildlife concentrations or agricultural operations). In 1996, the sampling program shifted to provide baseline data on the overall presence of these waterborne protozoa in the watersheds. Samples have since been collected twice monthly at CVA and Ware River Intake. DWM has an outside laboratory analyze many of these samples.

Water Quality Reports

Data from routine water quality sampling are found in a series of annual water quality reports (MDC, 1989-1990). Additional data from special studies and from other sources were sometimes included in historic sanitary surveys. Since 2000, watershed sanitary surveys have included water quality assessments of individual sub-basins (including biomonitoring data where available).

8.1.2 Assessement

Watershed Routine Monitoring

Since 1938, the MDC staff has consistently monitored the water quality of tributaries and ponds in the Quabbin Reservoir and Ware River watersheds. This monitoring program is designed to meet the long-term objectives noted earlier in this subsection. The current sampling program in the Quabbin Reservoir and Ware River watersheds is similar to the Wachusett program. Samples are collected regularly at a number of stations on tributaries and ponds. All elevated results are investigated to identify any upstream sources of contamination and to correct any identified problems. Additional non-routine samples are collected to document incident response activities and to aid in enforcement actions. As mentioned earlier, the reservoir is monitored monthly.

Habitat Assessment Method

Nine weighted habitat parameters selected by EPA for use in rapid bioassessment work were examined and given scores: bottom substrate, embeddedness, current velocity, channel alteration, bottom scouring and deposition, pool/ riffle ratio, bank stability, bank vegetation, and streamside cover. Scores were then added together to provide a numerical assessment of the habitat.

Figures 8-1 A & B show the 1999 water quality monitoring locations in the Quabbin Reservoir watershed and Ware River watershed, respectively. **Table 8-1** summarizes the sampling and analysis frequency by water quality parameter. Biweekly (every two weeks) DWM staff collects water samples to measure fecal coliform, temperature, dissolved oxygen, pH, and conductivity at 31 stations on 20 tributaries and 7 ponds. Quarterly analyses of pH, alkalinity, turbidity, hardness, color, and total and fixed solids are performed on samples taken from the same 31 stations. MDC/DWM intends to integrate additional sites and parameters measured based on past collaborative work with UMass-CEE.

Using historic data for all Quabbin Reservoir and Ware River watershed tributaries, expected ranges for each parameter at each location have been established. Any data falling outside of these ranges are examined immediately in an attempt to determine the cause. Re-sampling and detailed field investigations take place when warranted, with corrective measures proposed, if necessary.

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MDC/DWM Water Quality Sampling Stations

Quabbin Reservoir Watershed -- 1999

Statute Miles

0 1 2 3 4 5

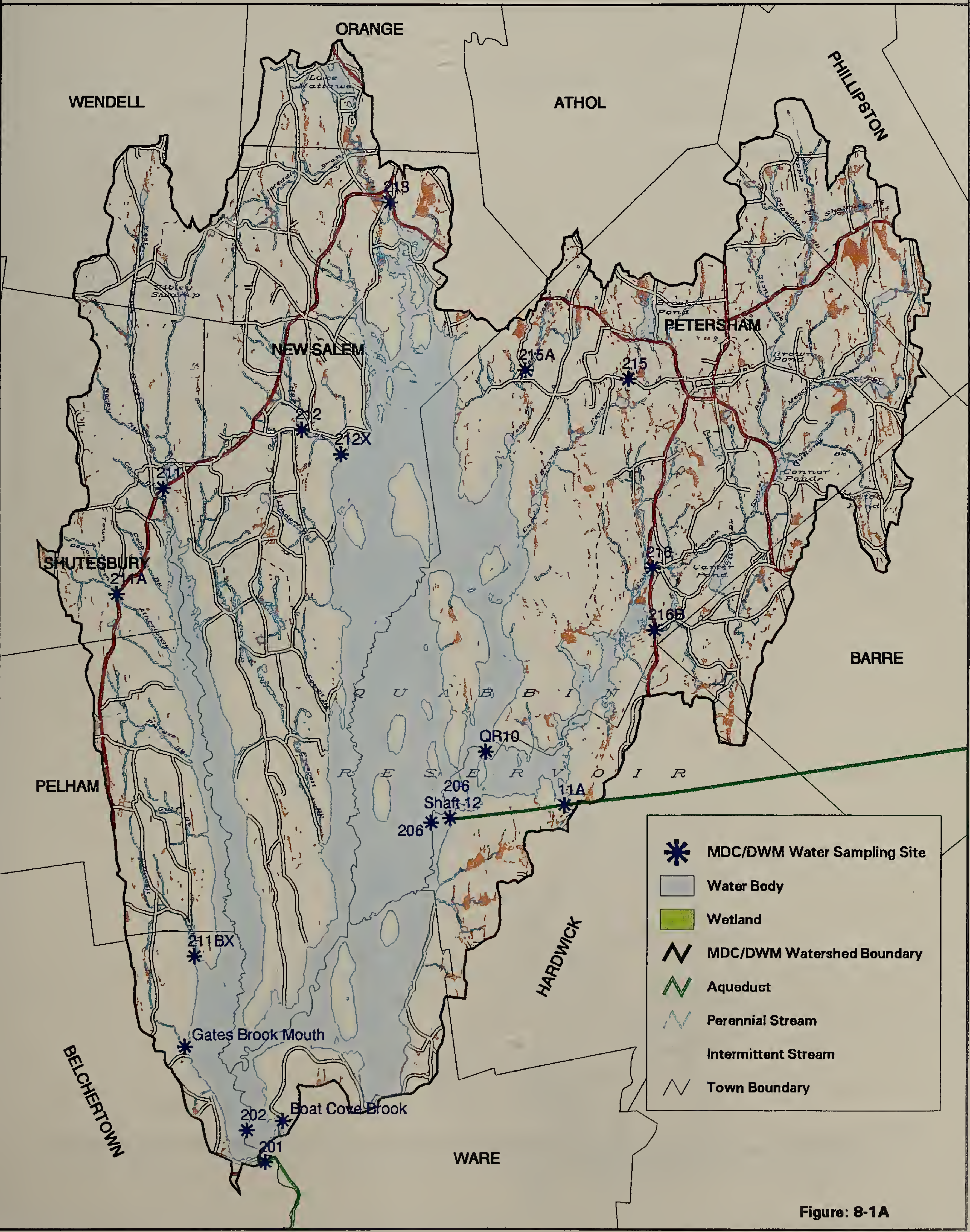
ORANGE
WENDELL
ATHOL
PHILLIPSTON
Lake Mattawa
213
NEW SALEM
PETERSHAM
215A
215
212
212X
211
SHUTESBURY
211A
216
216B
BARRE
Q U A B B I N
QR10
R E S E R V O I R
206
Shaft 12
206
11A
PELHAM
211BX
HARDWICK
Gates Brook Mouth
BELCHERTOWN
202
Boat Cove Brook
201
WARE
MDC/DWM Water Sampling Site
Water Body
Wetland
MDC/DWM Watershed Boundary
Aqueduct
Perennial Stream
Intermittent Stream
Town Boundary

Figure: 8-1A

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MDC/DWM Water Quality Sampling Stations

Ware River Watershed -- 1999

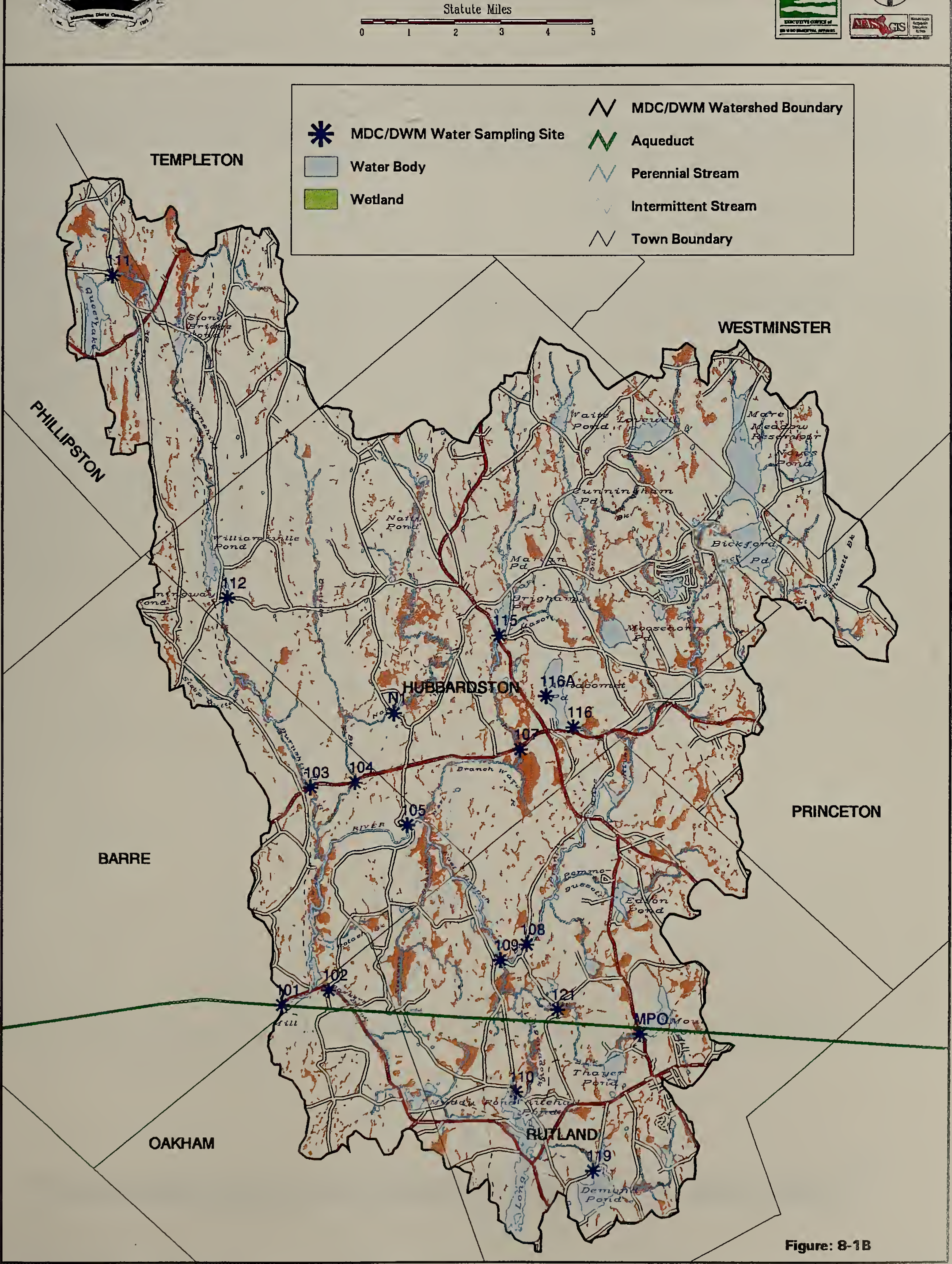
Statute Miles
0
1
2
3
4
5
MDC/DWM Water Sampling Site
Water Body
Wetland
MDC/DWM Watershed Boundary
Aqueduct
Perennial Stream
Intermittent Stream
Town Boundary
TEMPLETON
PHILLIPSTON
WESTMINSTER
HUBBARDSTON
PRINCETON
BARRE
OAKHAM
RUTLAND
111
112
115
116A
116
N
107
103
104
105
108
109
101
102
121
MPO
110
119
Queen Lake
Stone Bridge Pond
Williamsville Pond
Natty Pond
Waite Pond
Mare Meadow Reservoir
Bickford Pd
Brigham Pd
Moosehorn Pd
Comet Pd
Edson Pond
Thayer Pond
Demond Pond
Long Pond
Ware River
Branch Ware R

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Table 8-1

MDC/DWM Routine Water Quality Monitoring Program (2000)

Quabbin Reservoir Watershed and Ware River Watershed

Station Location	*MDC Site #*	*DO*	*Temp*	*pH*	*Cond*	*Fecal*	*Alk*	*Turb*	*Hard*	*Color*	*Total Fixed*	*Fixed*
Quabbin Reservoir												
CVA Outlet	201	W	W	W	W	D	W	W	Q	Q	Q	Q
Shaft #12 shoreline	206	W	W	W	W	W	W	W	Q	Q	Q	Q
CVA Intake	202	M	M	M	M	M	M	M	Q	Q	Q	Q
Site of Old Quabbin Lake	QR06	M	M	M	M	M	M	M	Q	Q	Q	Q
Den Hill	QR10	M	M	M	M	M	M	M	Q	Q	Q	Q
Shaft 11A	950	W[1]	W[1]	W[1]	W[1]	W[1]	W[1]	W[1]	Q	Q	Q	Q
Quabbin Reservoir Watershed												
East Branch Swift River	216	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
West Branch Swift River	211	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Middle Branch Swift River	213	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Hop Brook Mouth	212x	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Hop Brook	212	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
East Branch Fever Brook	215	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
West Branch Fever Brook	215A	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Cadwell Creek	21BX	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Rand Brook	216B	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Atherton Brook	211A	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Gates Brook	Gates Brook	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Boat Cove Tributary	Boat Cove	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Ware River Watershed - Queen Lake	111	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Burnshirt River	112	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Natty Pond Brook	N1	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Canesto & Natty Brooks	104	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Burnshirt River	103	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Ware River	105	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Parker Brook	102	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Long & Whitehall Pond	110	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
West Branch Ware River	107	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Asnacomet Pond	116	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Ware River	105	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
East Branch Ware River	108	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Longmeadow Brook	109	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Mill Brook	121	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Brigham Pond	115	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Moulton Pond	Moulton	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q
Demond Pond	119	BW	BW	BW	BW	BW	BW	BW	Q	Q	Q	Q

Source: (MDC/DWM, Quabbin Laboratory, 2000) D = daily; W = weekly; BW = biweekly (every two weeks); M = monthly

[1] This sample is taken weekly during diversion events.

DWM conducts in-depth stream survey studies within sub-basins in which coliform levels have been elevated in previous years. In-depth studies of sub-basins with elevated coliform are part of new watershed sanitary surveys.

In addition to the routine watershed monitoring, DWM collects unscheduled samples as needed, to document problems (including failing septic systems, illegal discharges, hazardous materials spills, and runoff from construction, agricultural, and recreational sites), and to support enforcement actions with the appropriate state agency (e.g., DEP, DFA, etc.).

Reservoir

Sampling Quabbin Reservoir helps provide DWM with an understanding of reservoir hydrodynamics and a basis upon which to guide reservoir operations. Data collected also provide insight into the relationship between nutrient concentrations and algal population dynamics, which enables more accurate predictions of potential taste and odor problems.

Fecal coliform bacteria samples are currently collected daily, Monday through Thursday, from the surface at the Cosgrove Intake. Samples are collected morning and evening seven days per week during the period (October-April) when large numbers of gulls, geese, and ducks are attempting to roost on the reservoir. Since 1990, fecal coliform samples have also been collected from 3 surface stations across the reservoir throughout the year, with more frequent collection during the period when birds are present. Prior to 1990, DWM sampled more reservoir sample sites. Temperature, dissolved oxygen, pH, and conductivity profiles are taken monthly or more frequently at five reservoir stations during ice-free periods.

A similar sampling program is underway at the Quabbin Reservoir, although no samples for nutrient or algae are currently being collected. In 1998, algal monitoring at the Quabbin Reservoir was initiated to provide information on algal dynamics and potential taste and odor problems.

As described above in **Section 8.1.1**, MWRA conducts regulatory monitoring at the CVA inside the Winsor Power Station at Quabbin Reservoir and Ware River Intake, as well as throughout the transmission and distribution system.

Pathogens

The 1999 pathogen monitoring program continues on a routine/baseline sampling approach. Samples for *Giardia* and *Cryptosporidium* are collected twice a month at CVA and Ware River Intake (when transfers are occurring). Within the next five years, it is likely that future sampling efforts will be determined following discussions with the MDC/MWRA pathogen working group.

Giardia and *Cryptosporidium* samples will also be collected as needed to assess the impacts from various activities, and to determine if BMPs are effectively removing pathogens from stormwater before it reaches tributaries and the reservoir.

Algae

Algae populations in the Quabbin Reservoir are of critical importance to the aesthetic qualities of water (EPA secondary standards), and have been implicated in past taste and odor episodes. MWRA receives and records complaints when these events occur. In 1998, MDC/DWM, in collaboration with MWRA and UMass, initiated a program to document algae-nutrient relationships.

Algae samples are currently collected monthly at six main stations at three depths in the reservoir. Monitoring results have confirmed the reservoir's "ultra-oligotrophic" status based on very low concentrations of total phosphorus and total inorganic nitrogen detected (See **Section 2.4.5.**).

Research (Special Studies)

Special studies and intensive sampling programs will continue during the next five years, focusing on refining our understanding of the watersheds at the sub-basin level.

Algae Methods

Half-liter samples are concentrated by gravity filtration through sand and silk in Sedgewick-Rafter funnels. A one mL subsample is first scanned using a 7-45X stereozoom dissecting microscope and then examined at 100X magnification. Algae are identified and counted in three strips, comprising approximately 10% of the subsample.

UMass Coliphage Study

The DWM-funded University of Massachusetts research project continues in year 2001. This monitoring project aims to improve understanding of fecal coliform contamination in the watershed by testing the application of various analytical methods and parameters to differentiate between contamination from humans and contamination from animals. Initial results are promising. Locating the source of fecal coliform in a tributary will be simplified if it is possible to first determine if the bacteria are from humans or animals.

The microorganism population present in a water body can be made up of environmental organisms (organisms that can be found living in the environment, but are not clinically significant), pathogenic organisms, or both. Traditionally, indicator organisms such as total coliform bacteria, fecal coliform bacteria, and *E. coli*, are used to screen surface waters for the potential presence of pathogenic organisms. Indicator organisms are widely used, and can provide useful information such as the potential presence and extent of fecal contamination; however, their presence does not allow the analyst to determine the source of the fecal contamination. Typically, DWM staff needs to perform additional testing and analyses to determine the source of the contamination to correct the problem.

In 1996, DWM began a cooperative research relationship with the University of Massachusetts, Department of Civil and Environmental Engineering to investigate and develop methods to differentiate microorganisms found in watershed surface waters. A comprehensive literature review was conducted to gather information on other potential testing methods. Several methods were screened, and three tests were selected as having potential to identify specific microorganisms in the watershed system. These are:

- *Bifidobacteria* - a bacterium which is a specific indicator of human fecal contamination,
- *Rhodococcus coprophilus* - a bacterium found in animals, and
- *F specific RNA coliphage* - a bacteriophage which can be indicative of human fecal contamination.

Working with DWM staff, the researchers are further developing these tests for evaluation of their accuracy to determine actual sources of fecal contamination, and for use by DWM staff in the water quality laboratory. This research work recently received American Water Works Association Research Foundation funding. The funding now supports an in-depth study of one sub-watershed, including land use and field studies, to investigate a possible link between land use/land cover and the previous refined microbiological work.

Evaluation of Nutrient-Algae Relationship at Quabbin Reservoir
DWM has conducted additional studies of nutrient concentrations and algae populations at the reservoir beginning in 2000. These studies will help better understand spatial and temporal differences in algal concentrations in the Quabbin Reservoir, and will document the effectiveness of remediation efforts in selected sub-basins.

UMass/Amherst-Department of Natural Resource Conservation – MDC/DWM-Natural Resource Section
Since the fall of 1999, MDC Natural Resources staff have worked with UMass Dept of Natural Resources Conservation faculty to set up a paired watershed study of small (<250 acre) catchments. The project aims to establish background conditions, especially during storm events, and then monitor changes to tributary water yield and quality associated with carefully implemented forestry practices. Data are gathered at the base of two catchments, with field-deployed automated water monitors that collect data every fifteen minutes, 24 hours per day. Parameters measured include temperature, pH, conductivity, DO, turbidity, and water depth (height above fixed probe). The depth data will be correlated with data from 120 degree v-notch weirs just below the monitoring sites, so that all measurements can be correlated to catchment yield. Following sufficient calibration of the catchments to each other, the treatment catchment will be treated with conventional MDC/DWM timber harvesting, and monitoring will continue during and after treatment. In addition, each catchment has been populated with soil moisture monitoring tubes, and a centrally located local meteorological station is currently being installed. The overall objective is to quantify the effects of typical MDC forest management treatments on tributary water yield and quality.

8.1.3 Plan

8.1.3.1 Goals

MDC/DWM's top water quality goal for the metropolitan Boston water supply system is to minimize the risk of waterborne disease caused by pathogens.

8.1.3.2 Five-Year Objectives

In the next five years, DWM's primary objective is to develop a more thorough understanding of water quality changes over time and space to better assess fate and ultimate risk posed by pollutants originating in the watersheds.

8.1.3.3 Activities

1. Continue routine and non-routine water quality sampling, patrols, and inspections.
2. Integrate UMass monitoring of TOC, UV, etc. into MDC/DWM routine monitoring schedule.
3. Continue pathogen monitoring program.
4. Enhance the algae monitoring program.
5. Support and utilize the UMass Coliphage study.
6. Expand the nutrient-algae investigations in the Quabbin Reservoir.
7. Continue database management, data analysis, modeling, and reporting.

8.2 Flows

Accomplishments:

- Continued to collect data on tributary and stormwater flow to help understand water quality and operations issues.
- Installed more surface flow/staff gages and groundwater level monitoring wells throughout the watersheds.
- Conducted reservoir modeling and analyses to provide a better understanding of the hydrodynamic processes in Quabbin Reservoir.
- Collected stormwater flow monitoring data as part of the Wachusett Stormwater Management Study, which provides data to estimate times-of-travel.
- Organized MWRA Reservoir Operations Committee in 1996 to review and develop operating policies for the Quabbin and Wachusett Reservoirs.

Key Activities:

- Continue stream flow, groundwater flow, and stormwater flow gauging throughout the watersheds.
- Refine times of travel estimates for streams throughout the watershed.
- Continue hydrodynamic studies through consultant work and development of water quality models.

8.2.1 Program to Date

8.2.1.1 History

Historically, MDC flow monitoring focused on required releases from the Quabbin Reservoir to the Swift River. MDC is required to discharge a minimum of 20 million gallons per day (MGD). This release comprises the source/headwaters of the Swift River below Quabbin Reservoir.

In the past decade, MDC/DWM has worked to increase its understanding of stream flow, groundwater flow, and reservoir hydrodynamics, as they relate to intake water quality. These efforts also encompass in-house and consultant projects.

8.2.1.2 Recent Accomplishments

Stream Flow Gaging

As DWM expanded the overall watershed management program through the 1980s, focusing on water quality, it became clear that more information on tributary and stormwater flows was needed to understand influences on water quality and set priorities. Consequently, DWM installed surface flow gages and wells for monitoring groundwater levels. Two continuous flow gages, and eight staff gages were established in the Wachusett Reservoir watershed. Eight groundwater monitoring wells were installed and are read monthly. The continuous stream gages and the groundwater wells are maintained through a contract with the USGS, and the resulting data are reported in the USGS annual reports.

Stormwater Flows

Site-specific stormwater flow monitoring is conducted as part of ongoing stormwater sampling program in the Wachusett Reservoir Watershed. As part of the Wachusett Stormwater Management Study that CDM is producing for DWM, a time-of-travel map for the entire Wachusett watershed is being developed. The times-of-travel are established through field dye testing and mathematical modeling.

Reservoir Hydrodynamics

A detailed analysis of reservoir hydrodynamics is being conducted by the University of Massachusetts, Civil and Environmental Engineering Department. This project is providing a better understanding of the processes in the reservoir. **Section 2.3.5** discussed significant conclusions. DWM will continue with such efforts.

Reservoir Operations

An MDC-MWRA Reservoir Operations committee was set up in April 1996 to review and develop operating policies for the Quabbin and Wachusett Reservoirs. The reservoirs must be managed to provide adequate water supply, to minimize downstream flooding, and to protect the water quality. The goal of the committee is to analyze existing and proposed reservoir operation and transfer policies by developing a model to simulate operations, and by running the model to determine the most effective way to transfer and store water. MWRA staff completed developing the computer model of the system using the STELLA research modeling software. The committee developed a revised transfer rule, and a pilot implementation of this transfer rule was conducted in fall 1997. MWRA and MDC/DWM are continuing to examine different operation scenarios and hope to finalize a new policy in 2001.

8.2.2 Plan

8.2.2.1 Goals

Understanding the hydrology and hydrodynamics of the watershed-reservoir system is important to the overall effectiveness of the watershed management program. Such information will assist in setting priorities among various programs, identifying tributaries of most significance, establishing limits (for recreation activities, bird control, etc.), and responding to any emergency spill.

Through flow monitoring/modeling, DWM seeks to attain a better understanding of:

1. Stream discharges and times of travel throughout the watersheds;
2. How primary streams (e.g., streams that directly discharge to the reservoir) influence Quabbin Reservoir and the fate of and associated risk from pollutants in these streams.
3. Reservoir hydrodynamics;
4. The fate of pathogens and other pollutants from gulls and other wildlife; specifically, the adequacy of no-bird zone/pathogen control zone; and
5. The impact of reservoir operating decisions on water quality.

8.2.2.2 Five-Year Objectives

Over the next five years, DWM's primary objective is to develop a more thorough understanding of stream discharge and reservoir dynamics to better assess fate and ultimate risk posed by pollutants originating in the watersheds.

8.2.2.3 Activities

1. Continue use and operation of stream gages, ground water monitoring wells, and periodic published reports of data.

2. Collect field data.

3. Continue stormwater flow monitoring.

4. Continue hydrodynamic study of Quabbin Reservoir.

5. Assess need to continue development/refinement of 2-dimensional water quality model of Quabbin Reservoir.

8.3 Watershed Sanitary Surveys

Accomplishments:

- MDC/DWM has maintained an established and ongoing watershed sanitary survey program within the Quabbin Reservoir and Ware River watersheds since the 1940s to correct existing and potential threats to water quality, and to ascertain compliance with state and federal regulations.
- Refined survey approach by DWM to conduct the sanitary surveys on the sub-basin and sub-district levels, providing more detail in determining possible sources and causes of contamination.
- Established working relationships between DWM staff and other municipal and state entities to add informative data to the survey.
- Developed a rotating schedule to ensure a complete investigation of every sub-district (a.k.a., sub-basin) level once every five years.

Key Activities:

- Continue to conduct sanitary surveys with the refined approach on a sub-basin or sub-district level, producing a report with an assessment for each sub-basin every five years.
- Conduct in-depth studies on several sub-basins or sub-districts in which coliform levels have been elevated in previous years.
- Develop a data collection system for comprehensive analysis and assessment.

8.3.1 Regulatory Context

An evaluation of a water supply system, in conjunction with a water quality monitoring program, is essential in determining the sanitary quality of drinking water within the system. These evaluations are commonly referred to as sanitary surveys. The EPA's National Drinking Water Regulations (CFR 141) defines the term as: CFR 141.2(f) "Sanitary Survey means an on-site review of the water source, equipment, operation and maintenance of a public water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation and maintenance, for producing and distributing safe drinking water." DWM is responsible for the water from the watershed to the point it leaves the reservoir. Therefore, as it relates to the definition of sanitary surveys, DWM is responsible for completing a review of the source water system, including the entire watershed that ultimately contributes water to the supply reservoir.

The authority and obligation to perform sanitary surveys or watershed inspections is derived from both Federal and State drinking water regulations, as well as from accepted water supply practice. First, EPA and state agencies with primacy for drinking water regulations have traditionally performed sanitary surveys of the water systems they regulate. Such surveys, performed for all different types of systems, typically include an on-site inspection and completion of a form addressing the watershed or zone of contribution, intake or well, treatment works, and distribution system. Secondly, the SWTR and state regulations require an annual on-site inspection of unfiltered systems. EPA guidance indicates that the primacy agency or a party approved by the primacy agency must perform the on-site inspection. The required on-site inspection includes a review of the effectiveness of the watershed control program, the intake, and the disinfection process. Third, state regulations 310 CMR 22.20 (9) state:

> "The supplier of water shall cause regular and thorough inspections to be made of the watershed to ascertain compliance with 310 CMR 22.21. The aforesaid supplier of water shall report to the Department in writing annually...the results of the regular inspections.... The report shall state the number of inspections which were made, the number of violations found, the number of notices served, the number of violations abated and the general condition of the watershed at the time of the last inspection."

For Quabbin Reservoir and Ware River watersheds, DWM has taken responsibility for regular watershed sanitary surveys (a.k.a., sanitary surveys) of the watersheds. According to a condition of the existing DEP Administrative Consent Order (ACO) to avoid filtration, the DEP conducts formal annual on-site inspections of the Quabbin Reservoir and Ware River watersheds. Based on these inspections, the MDC/DWM and MWRA have remained in compliance with all applicable regulatory requirements for the Quabbin Reservoir to maintain the DEP's Waiver of Filtration. The MDC/DWM is committed to the successful completion of projects and actions required by the ACO and DEP's annual recommendations regarding the MDC/DWM's progress of the implementation of the current Watershed Protection Plan.

8.3.1.2 DWM Watershed Sanitary Survey Program

Between the 1920s through the late 1980's, MDC's sanitary surveys changed. In the 1940's MDC staff would include inspections of individual homes in the watersheds. These inspections documented the number, locations, and functionality of sanitary waste facilities. Staff inventoried animal populations (e.g., number of chicken, cattle, etc.). As late as the 1960's, the MDC would fix or replace failing septic systems of residential homes in the Quabbin Reservoir watershed. The staff would investigate and eliminate every known source of pollution. However, over the years, until 1988, MDC's sanitary surveys became less detail oriented because the watershed populations have increased.

DWM and its predecessors have made periodic watershed sanitary surveys of the watersheds for decades. Historical MDC documents reference inspections in the watersheds early in the century. Stemming from the 1986 SWTR and the reorganization and establishment of DWM in 1985, DWM began comprehensive sanitary surveys of the watershed in 1988 as a key component of the overall watershed protection program strategies.

By statute, MDC is responsible for the management of the watershed system which serves as the source of the water delivered to the Metropolitan Boston and Western Massachusetts service areas of the MWRA. By operation of the same statute, Chapter 372 of the Acts of 1984, the MWRA is responsible for the treatment and distribution of finished water to its service area municipalities. As MDC's Division of Watershed Management is responsible for protecting the water quality of the sources of supply prior to treatment and distribution by the MWRA, the MDC/DWM's Watershed sanitary surveys necessarily focus on the watershed system, more in line with the traditional definition of sanitary survey:

> "A sanitary survey of a watershed is primarily a determination of the amount and distribution of the waste products deposited on its surface or in its streams resulting form its occupancy by human agencies together with a determination of the effects of this waste disposal upon the character of the water draining from the watershed." (House No. 262, Appendix B, Results of a Sanitary Survey of the Watershed Areas of the Metropolitan Water District, 1938).

In 1989, the Division's Environmental Quality Section, the group responsible for conducting watershed sanitary surveys, adopted the definition of sanitary survey to mean: the identification of all existing or potential sources of pollution in a sanitary district and the assessment of the effects of such sources on the quality of water within a sanitary district and on waters of the watershed system.

From 1989-1994, these detailed surveys were completed for each of the four sanitary districts at Quabbin Reservoir and Ware River watersheds. These surveys consisted of conducting field inspection, compiling water quality data, reviewing existing information (from individual pollution sites to soils), conducting an inventory of resources, evaluating current and potential threats to water quality, and recommending corrective actions. A second round of sanitary surveys started in 1995. Sanitary survey reports are published and are available for review. In 1999, the DWM renamed the watershed sanitary survey to watershed sanitary inspection, in order to minimize confusion between the activities required by Federal law and the activities conducted by DWM staff as part of its comprehensive watershed protection program.

8.3.2 Current and Planned Program

8.3.2.1 Goals

The challenge of watershed management is to identify and then eliminate, reduce, or control all the pollution threats and the pollution transport pathways in the watersheds. The goals of the watershed sanitary survey program are to provide a comprehensive view of existing and potential threats to the water supply, and to provide a framework for prioritization of DWM activities within the watershed.

8.3.2.2 Approach

While previous sanitary surveys aided in implementing the Plan, they tended to be nonspecific about problem areas. In addition, due to the size and complexity of the sanitary districts, past reports have been broad in their assessment of water quality threats. To improve effectiveness of watershed protection efforts and to prioritize the programs which monitor and manage existing and potential water quality threats, DWM refined its approach to conducting watershed sanitary surveys. The watersheds have been divided into sanitary districts since the 1940's; each district has been further divided into sub-district or sub-basin where possible. This sub-basin/sub-district approach was adopted to more easily identify and relate observed water quality problems with sources of contamination in the tributaries of the watersheds of the Quabbin Reservoir and Ware River. These inspections provide a thorough analysis of the health of each individual sub-basin, allowing DWM to define specific goals for maintaining and improving water quality in each basin area. Quabbin Reservoir watershed and Ware River watershed Sanitary Districts and Sub-districts are shown on **Figure 2-1A & Figure 2-1B**, presented previously, in **Section 2**.

The watershed sanitary survey approach is based on the fundamental concept that water is the primary vector for pollutant transport. Therefore, the new watershed sanitary surveys require development of a detailed hydrology of the watershed using existing mapping and field inspections, identifying all potential sources of contamination and their hydraulic/hydrologic connection to the water resources, and assessing water quality at the terminus of the basins.

8.3.2.3 Procedure

All DWM staff (e.g., staff from the sections of Environmental Quality, Environmental Planning, Forestry, Natural Resources, Civil Engineering, Interpretative Services, Watershed Rangers, maintenance crews, etc.) conduct programs designed to protect the watershed environment and the drinking water supply. In concert with the revised watershed sanitary survey approach, all programs and contracts throughout DWM are now referenced by sub-district or sub-basin.

The first step in a watershed sanitary survey is to collect all available information concerning the sub-basin. Some of the key programs or projects relevant to the sanitary survey are identified in **Table 8-2** (each program is detailed elsewhere in this Plan).

In addition to internal data sources, DWM staff established a working relationship with other municipal and state entities (e.g., local Public Works, BOH, Conservation Commission, Fire Departments, DEP, MHD, etc.) who have overlapping concerns with the environment and the water supply. As a result of these relationships, DWM has access to pertinent municipal and State records and files. DWM staff collects this information, documenting it by sub-basin.

The next step is to enter these records into a relational database linked with MASSGIS base maps generated for each sub-basin or sub-district. These working maps include topography (3 meter contours), lot delineation (including assessor's map and lot numbers), and hydrology (streams and wetland resources, DEP hydrology), plus records of potential pollution sources. The base maps allow all the program efforts to be presented together (overlaid),providing a complete "picture" of all water quality-related issues and facilitating the watershed sanitary survey.

Environmental Quality personnel conduct a detailed field inspection to gain first-hand knowledge of the ground threats to water quality. Through the field inspection, the entire reach of each brook, including associated tributaries, is walked, stormwater drainage systems (outfalls) are delineated, and the perimeter of the sub-basin watershed is inspected on foot or by automobile (windshield survey). Natural Resources staff also perform field inspections to evaluate wildlife populations and habitat areas within the sub-basin or sub-district. As requested by Environmental Quality staff conducting the watershed sanitary survey, other DWM staff conduct detailed field inspections of sites relevant to their particular programs. This field inspection serves to verify and update the existing base maps.

Table 8-2

Key MDC/DWM Programs or Projects Relevant to MDC/DWM Watershed Sanitary Surveys

MDC/DWM Program or Project	***Relevance to Watershed Sanitary Surveys/Responsible Parties***
Water Quality Investigations	MDC EQ Section response to fluctuations in water quality monitoring data and/or reports of activities or situations which may degrade water quality
High Risk Area Inspections	MDC EQ Section conducts weekly inspections of the intake and other High Risk Areas
Stormwater Management	MDC EQ Section, DEP and local Conservation Commissions
Watershed Protection Regulations Watershed Protection Act	MDC/DWM staff MDC EP/EQ Sections
Public Education	MDC/DWM Interpretative Services, Watershed Rangers and other DWM staff
Land Acquisition	MDC Natural Resources Section
Water Quality Monitoring	MDC EQ and Natural Resources
Cooperative Agricultural Management	MDC EQ Section/NRCS/Mass DFA
Wildlife Identification Control and Management	MDC Natural Resources, EQ, and watershed maintenance crew
Hazardous Waste Inspection	MDC/DEP cooperative effort (DEP enforcement)
Underground Injection Control Program	MDC/DEP cooperative effort
Septic System Failure Monitoring	Cooperative effort between MDC, DEP, and local BOHs
Sedimentation and Erosion Control Monitoring	Cooperative effort between MDC, DEP, and local Conservation Commissions
Hazardous Material Releases to the Environment	DEP/Waste Site Cleanup (monitored by MDC)
State and Federal Regulatory Programs and Permits	
➢ NPDES Permits	EPA/DEP cooperative effort, informal DWM review and comment
➢ Groundwater Discharge Permits	DEP/MDC, informal DWM review and comment
➢ Registered and Permitted Withdrawals	DEP/Bureau of Resource Protection, DWM review and comment
Forest Management Programs	MDC/DWM & DEM cooperative effort

Source: (MDC/DWM, 1998)

Water quality data, especially in the tributaries, is one of the major tools used to identify and evaluate pollution sources within a sub-basin or sub-district. This data is used in conjunction with the field inspections and site records to efficiently and effectively track pollution problems to their source. Conversely, the sub-basin or sub-district watershed sanitary survey may identify the need for certain water quality sampling to investigate potential sources of fecal coliform bacteria or other contamination that may currently be undetected.

After the detailed review of each sub-basin or sub-district is complete, recommendations for actions necessary to maintain or improve water quality are generated. Staff for each of the programs occurring in a sub-district or sub-basin develop the recommendations. DWM will then combine, review, and prioritize the recommendations before final report recommendations are adopted as action items. Last, the final watershed sanitary survey report is produced, summarizing the data gathering, analysis, conclusions, and recommended actions, and setting forth a schedule of action items and completion schedule.

The DWM's sub-basin or sub-district approach to watershed sanitary surveys has been under development since early 1997 and continues to improve. To aid in the new watershed sanitary survey process, DWM will, with consultant assistance, assess the current database system. This system, in the software Access™, has been developed by Environmental Quality Section staff and includes the field inspection tables, parcel property owner database, agricultural site database, water quality data, and others. The goal is to create a central system for information processing and retrieval for both spatial and temporal data.

8.3.2.4 Rotating Schedule

A rotating schedule for watershed sanitary surveys was developed to complete a detailed investigation in each Sanitary District in each watershed, once every four years. There are four Sanitary Districts in both the Quabbin Reservoir and Ware River watersheds; thus, once the schedule is established, one report will be completed every year.

The entire watershed sanitary survey process will typically last for three years. The first year will involve the field work, data collection, and report writing. The annual sanitary survey will include current reports such as annual water quality reports, gull control reports, weekly inspection reports of high risk areas, WsPA summaries, and Watershed Ranger reports. The second year will focus on addressing report recommendations in the district. This will include initiating technical assistance projects, beginning implementation of recommendations, inspecting progress of recommended improvements being implemented by others, and conducting follow-up water quality investigations as needed. The third year will include a brief update including a summary of completed projects, the status of projects underway, an outline of steps for completion, and identification of unresolved issues. The forth and fifth years will involve documentation of ongoing work in each basin. Further investigations during these two years will only occur when water quality monitoring identifies changes in water quality or complaints warrant investigation. In addition, the database information will be updated continuously.

Sanitary Survey Database

Growing out of the revised sanitary inspection process, staff worked to set up computer databases to track ongoing activities in each sub-basin. The intent of this extensive undertaking is twofold. First, these databases will be used to summarize activities and sites as the initial step of each survey. But, even more importantly, these databases will allow for a continuously up-to-date record of programs and activities in each sub-basin or sub-district

Each Section's personnel are responsible for maintaining a base map and or database (if applicable) to track their programs/ tasks in each sub-basin. These databases will provide all DWM staff with information on the control and monitoring efforts in each sub-basin, which will facilitate investigations in any area where water quality monitoring identifies problems. Having updated information will allow staff to more easily identify problem activities or to relate changes in water quality (improved or degraded) to a specific activity or activities.

8.3.3 Plan

8.3.3.1 Goals

Understanding land use and land cover of the watershed-reservoir system is important to the overall effectiveness of the watershed management program. Such information will assist in setting priorities among various programs, identifying tributaries of most significance, establishing limits (for recreation activities, bird control, etc.), and responding to any emergency spill.

8.3.3.2 Five-Year Objectives

In the next five years, DWM's primary objective is to develop a more thorough understanding of land use and land cover changes over time and over space, to better assess fate and ultimate risk posed by pollutants originating in the watersheds.

8.3.3.3 Activities

1. Complete MDC/DWM Watershed Sanitary Surveys in the Quabbin Reservoir watershed and the Ware River watershed on the prescribed cycle; conduct remediation actions, as necessary.

2. Develop and maintain watershed sanitary survey database.

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Section 9
MDC/DWM Management

Since its' formation in 1986, MDC/DWM's budget and staffing have increased significantly. Currently, DWM has 173 employees, including 80 professionals. This cadre of environmental personnel, supplemented by the use of consultants, enables DWM to make major strides in protecting its watersheds. For the next-five year period, DWM plans to fill existing vacancies and to make modest additions and shifts in staffing, which will increase the annual expenditures to fund these positions and to implement BMPs focusing on stormwater and agriculture to a $12.5 to $13.5 million projected budget range.

9.1 Organization and Staff

9.1.1 DWM Organization

The 173 members of the DWM staff perform a variety of duties, in locations which range over 100 miles, from Boston to the Pioneer Valley in Central Massachusetts. DWM staff includes engineers, regional planners, wildlife biologists, aquatic biologists, foresters, chemists, skilled tradesmen, administrative assistants, accountants, bookkeepers, and other professionals.

Figure 9-1 shows the DWM organization chart and the numbers of anticipated staffing for Fiscal Year 2001 through 2004. Staff within DWM are organized into Administration, including service units that support the entire Division; the Division Technical Section, providing policy and planning; and the field-based Quabbin/Ware Operations Section and Wachusett/Sudbury Operations Section. Within this structure, there are six core programs:

- Environmental Quality (EQ);
- Environmental Planning (EP);
- Interpretative Services;
- Civil Engineering (CE);
- Natural Resources (NR);
- Forestry; and
- Watershed Rangers.

The EQ and CE programs are represented at both the DWM policy level and in the Operations Sections. The NR program is DWM level only, conducting land management and public access planning. The Forestry and Ranger programs are organized in the Operations Sections; staff in these programs coordinate extensively with DWM-level functions (EQ, EP, NR).

In the following sections, the functions and activities of each unit are described. Also, staff qualifications and training are described, as required by DEP Measures of Success Staffing items.

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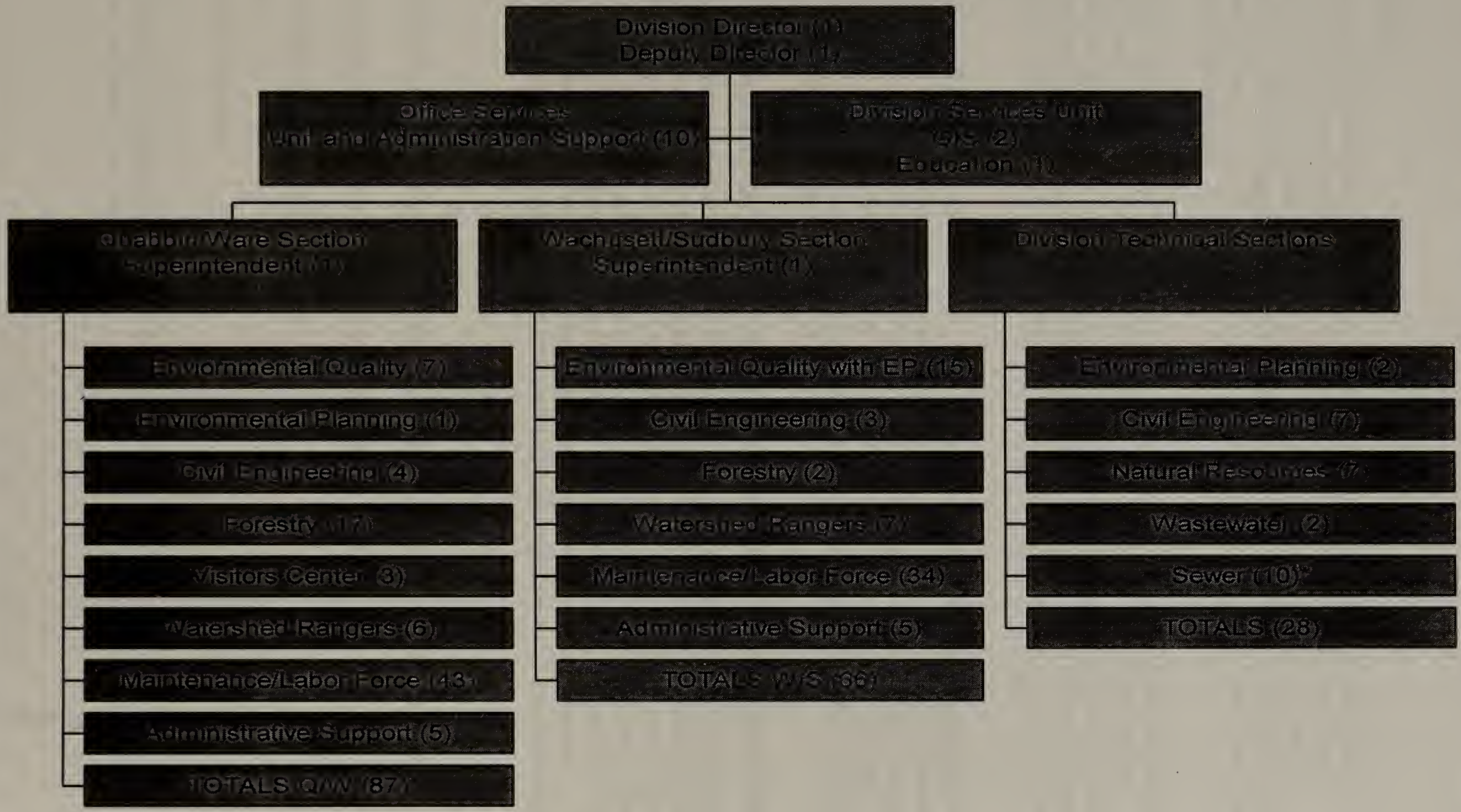
Figure 9-1
MDC/DWM Organization and Anticipated Staffing
FY00-FY04


Division Director (1)
Deputy Director (1)
Office Services
Unit and Administration Support (10)
Division Services Unit
GIS (2)
Education (1)
Quabbin/Ware Section
Superintendent (1)
Wachusett/Sudbury Section
Superintendent (1)
Division Technical Sections
Environmental Quality (7)
Environmental Planning (1)
Civil Engineering (4)
Forestry (17)
Visitors Center (3)
Watershed Rangers (6)
Maintenance/Labor Force (43)
Administrative Support (5)
TOTALS Q/W (87)
Environmental Quality with EP (15)
Civil Engineering (3)
Forestry (2)
Watershed Rangers (7)
Maintenance/Labor Force (34)
Administrative Support (5)
TOTALS W/S (66)
Environmental Planning (2)
Civil Engineering (7)
Natural Resources (7)
Wastewater (2)
Sewer (10)*
TOTALS (28)

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9.1.2 Administration

The Administration Section is responsible for specific support including procurement, contracting, and human resources, to all other DWM activities and sections. The Administration Section coordinates communication with all other MDC Divisions and departments (Human Resources, Payroll, Finance, Contract Administration, Labor Relations, Public Information, Commissioner's Office, Legislative Liaison, and Office of General Counsel). The administration section is also responsible for coordination with other State, regional, and Federal agencies.

There are two principal sub-units within the Administration Section: the Office Services and Support Unit and the Division Services Unit. Office Services and Support represents primarily finance and office management staff, bookkeepers, clerks, and contract support. The Division Services Unit provides technical services to DWM staff and includes GIS and other MIS support functions, graphics and educational program support, water resources and watershed facts and public information database materials maintenance, and paralegal support.

GIS is a critical service of the Division Services Unit. Over the last ten years, DWM has increasingly used GIS to convey, analyze, and model spatial data. Since its early use in preparation of the original plans in 1991 and the implementation of the Massachusetts WsPA in 1992, the Division has made a firm continued commitment to optimize the use of this technology. In so doing, Division's efficiency and the quality, accuracy, and effectiveness of communications with watershed residents and town officials has improved. DWM GIS staff prepared all the GIS maps included in this Plan Update.

9.1.3 Quabbin/Ware Section Operations and Wachusett/Sudbury Section Operations

The watershed system is managed at the field level within two major operations sections: the Quabbin/Ware Section and Wachusett/Sudbury Section, each managed by the section Superintendent. Watershed operations sections embrace a multitude of functions throughout the watershed system. The operations section include staff representing the EQ, EP, and CE sections; and Forestry, Watershed Rangers, and labor crews. The operations labor forces include skilled laborers, skilled tradesman (carpenters, painters, welders, etc.), motor vehicle mechanics, heavy equipment operators, and requisite supervisory foremen and sub-foremen positions. Generally, the labor force is organized into crews with specific regional- and functional-assigned responsibilities.

Responsibilities

The Quabbin/Ware and Wachusett/Sudbury Operations Sections maintenance crews are responsible for:

- Participating in the bird harassment program, under the direction of EQ;
- Maintaining DWM facilities and equipment including:
  - fire roads,
  - other roads and culverts,
  - buildings,
  - grass cutting and related grounds keeping on dams and shorelines,
  - vehicle fleet and heavy equipment, and
  - signs;

- Completing construction projects, such as erosion control BMPs (in conjunction with the ad hoc BMP group comprised of representatives of engineering, forestry, EQ, and NR); and
- Providing field support and assistance to other sections in the performance and maintenance of field projects.

The Operations Sections' crews are major participants in the Wildlife (e.g., Gull Harassment) Program, in constructing and maintaining BMPs in the Highway and Railway and Stormwater Management Programs, and in installing signage and barriers under the Public Access and Recreation program.

Qualifications and Training

Training for operations staff includes boat safety, water safety (cold water rescue and survival, etc.), fire suppression, bird harassment techniques, and erosion control practices.

9.1.4 Environmental Quality Section

Responsibilities

The EQ Section is responsible for major activities, such as remediation of pollution sources, monitoring, research, and technical review:

- Remediation: EQ staff oversee the Gull Harassment Program, coordinate hazardous materials release responses, and pilot BMPs to prevent, treat, and mitigate impacts of pollutants.
- Monitoring: EQ staff conduct all water quality monitoring of reservoirs and tributaries, including sampling and data analysis for NR and CE sections, encompassing tasks from sample collection through operation of analytical laboratories, and watershed sanitary surveys of watershed sub-basins and sanitary districts.
- Research: EQ is responsible for researching the sources, mobilization, transport, and fate of pollutants of concern to the water supply and the watershed system.
- Technical Review: EQ staff coordinate with local boards and commissions regarding enforcement of environmental regulations (e.g., Title 5, Wetlands Protection Act, Rivers Protection Act, WsPA, MEPA), conduct review of environmental impacts of proposed projects within watershed communities, and communicate with other State, Federal and local agencies on a wide range of environmental matters of concern.

EQ staff represent the Division on a number of interagency committees, such as the Pathogen Control Working Group, Algae Task Force, and similar informal water quality and modeling science working groups. EQ has primary responsibility for the Bird Harassment Program (which is staffed by Operations Section labor and professional personnel under EQ direction). EQ also is a member of DWM's internal Land Acquisition Policy Panel.

EQ staff are responsible for maintaining state-certified water quality laboratories at the Division's Quabbin and Wachusett Reservoir field offices. The section is also responsible for securing and maintaining contracts with qualified laboratories that perform analyses which cannot be conducted with DWM in-house capabilities. The MWRA and EQ routinely exchange data. EQ publishes annual water quality data reports, periodic sanitary survey reports, and other water quality and environmental assessment reports. A reference list of DWM reports is included in **Appendix C**.

The EQ section is responsible for the following programs outlined in this Plan Update: Major Environmental Regulations (with EP assistance), Wastewater Disposal, Agricultural BMPs, Stormwater Management, Highways and Railways (with CE and Operations involvement), Individual Sites, Emergency Planning and Response, Construction Sites, and all Monitoring programs.

Qualifications and Training

EQ staff members holds degrees in environmental engineering, civil engineering, public health, environmental science, biology, chemistry, and bacteriology. Three EQ staff members are registered Professional Engineers. To remain current with emerging issues, staff participates in a wide variety of professional organizations and participates in conferences and training events. These include:

- Membership in American Water Works Association (AWWA), American Society of Civil Engineers, North American Lake Management Society (NALMS), New England Association of Environmental Biologists.
- Attendance at DEP training courses for Title 5, Rivers Protection Act, and Stormwater BMPs. All staff who review on-site wastewater disposal have received soil inspector and system inspector certifications.
- Participation in conferences sponsored by professional organizations on topics such as watershed protection practices, water quality testing methods, *Cryptosporidium*, erosion control practices, and BMPs for agriculture.

9.1.5 Environmental Planning Section

Responsibilities

The EP Section was re-established in the Division in 1992, primarily in response to the additional administrative responsibilities placed on the Division pursuant to the passage of the WsPA (Ch. 36 MA Acts of 1992). The section is primarily responsible for the administration and enforcement of the rules and regulations promulgated to regulate land use and development within the primary protection and secondary protection zones created by WsPA throughout the watershed system (350 CMR 11.00, et seq.). The EP Section is also responsible for coordinating technical assistance to watershed communities with respect to planning, zoning, subdivision, and health bylaws specifically directed by WsPA, and for coordinating attendance at board and commission meetings with the other sections. EP also is an important participant on the Division's Land Acquisition Policy Panel.

In addition, EP has primary responsibility for the Community Technical Assistance Program and Watershed Protection Act implementation activities in this Plan.

Qualifications and Training

All staff in the EP Section has degrees in planning or urban studies/affairs, and all have graduate degrees in planning and related fields. Staff members belong to several professional organizations

EP staff have participated in training activities to keep staff knowledgeable about emerging issues relative to watershed protection. These include attending DEP training for stormwater, the annual American Planning Association conferences, Citizens Training Workshop, the Pure Water Stewardship Committee, and the former Non-Point Source Outreach Coordination Committee.

9.1.6 Interpretative Services

Responsibilities

The Interpretative Services staff operates the Quabbin Visitor Center and provides Public Education and visitor information for Quabbin Reservation. This material includes exhibits, written materials, audio-visual presentations, programs, and field interpretation. The staff maintains visitation records, handles access requests and permits, and acts as an MDC/DWM contact with the general public and special groups. The Interpretative Services staff also maintains and augments the DWM's reference library.

Qualifications and Training

Staff in the Visitor Center hold undergraduate and graduate degrees.

9.1.7 Civil Engineering

Responsibilities

The Civil Engineering Section is responsible for the inspection, maintenance, repair, reconstruction, and analysis of all dams and appurtenant facilities, bridges, roads, and buildings under DWM's care and control. These facilities include 12 major water supply dams and related hydraulic structure, 14 bridges and 419 miles of roads and fire roads, and 65 individual buildings and facilities. In addition to the facilities themselves, such ancillary systems as water supply, wastewater disposal, heating and cooling, structural analysis, roofing, and historical preservation must be monitored and incorporated into the section's activities. The Engineering Section also is responsible for construction contract review and administration on major construction projects at MDC watershed facilities.

The CE Section is responsible for maintaining and administering Emergency Action Plans (EAPs) pursuant to Federal Emergency Regulatory Commission (FERC) and MEMA requirements, based on the classification of most of the water supply dams in this system as "large, high hazard" structures. This effort includes regular engagement of independent engineering structural evaluations; preparation and communication of emergency action plans to federal, state, and local emergency agencies; and the conduct of standard telephone and operational drills of the EAPs at all facilities.

The CE Section's primary responsibility is maintenance of facilities, but the group also participates in design and construction oversight of projects within the Stormwater Management, Wastewater Disposal, Highways and Railways Programs, and aids in addressing structure removal on newly acquired lands under the Land Acquisition Program.

Qualifications and Training

Staff in the Civil Engineering Section hold degrees in civil engineering.

9.1.8 Natural Resources Section

Responsibilities

The NR Section is primarily responsible for managing natural resources associated with MDC/DWM-owned watershed land and providing technical assistance to non-MDC landowners. Major activities within this section include coordinating forestry and land management plans[1], wildlife management, developing plans and policies for public use and access to MDC/DWM lands and waters in the watershed, acquiring additional watershed lands considered critical for protection of the water supply, and monitoring against encroachments and trespass on MDC/DWM lands.

The NR Section conducts extensive research covering a broad range of issues related to the management and stewardship of forestry and wildlife resources, habitat management, ecosystem management, and biodiversity. This section also holds primary responsibility for the stewardship of historic and archaeological resources within the care and control of the Division.

In addition, the NR Section is responsible for the Wildlife Program (with EQ and Operations assistance for Gull Harassment), the Land Acquisition Program, outreach activities under Additional Protected Lands, and the planning aspect of the Land Management (forestry) program.

Qualifications and Training

Members of the NR Section have degrees in forestry, wildlife biology, planning, landscape architecture, and civil engineering. Staff belong to many professional organizations including Society of American Foresters and the Wildlife Society. In addition to this, some staff members are certified as foresters, arborists, and wildlife biologists. NR staff have attended conferences and professional training on such topics as: wetlands mapping, forest inventory methods, and identification and protection of rare species. NR hosts an annual symposium on forest management and watershed protection at the Quabbin Reservoir with 30-40 experts in the field. In 1998, NR sponsored an international conference on watershed forest management.

9.1.9 Forestry

Responsibilities

The Forestry group of each Operations Section include professional foresters. The Forestry staff is responsible for the annual planning, implementation, field oversight, and management of all forestry activity. In addition, foresters conduct field assessments and inventories of DWM forests and newly acquired lands, and direct the development of long-term forest management plans. The NR Section conducts the Private Lands Forestry activities, including preparation of forest management plans for Chapter 61 qualification, technical assistance on BMPs, and inspection of private silviculture activity.

Forestry is responsible for Land Management (forestry on MDC/DWM lands), and private forest lands activities under Additional Protected Lands.

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[1] The Operations Sections are responsible for conducting forestry management activities.

Qualifications and Training

MDC/DWM Foresters have degrees in forestry; many are members of the Massachusetts Association of Professional Foresters and the Society of American Foresters. All foresters will be licensed under the State's new licensing program. Foresters regularly attend conferences and professional training sessions on such topics as: forest health, biodiversity, wildlife management, wildlife firefighting and prescribed burning, and identification and protection of rare species.

9.1.10 Watershed Rangers

Responsibilities

The Division introduced Watershed Rangers in 1995. The Watershed Rangers are uniformed and trained primarily to maintain a positive, visual presence in the watersheds, to observe the behavior of individuals engaged in activities on watershed lands and waters, and to ensure that such activities occur within the applicable rules through education and interpretive interaction with the public[2].

The Watershed Rangers also are a key element in the Division's education and outreach program. Their uniformed and enthusiastic presentations and demeanor work well with young, impressionable audiences both in classroom and on-site educational presentations. The Rangers will help to establish lifelong attitudes of respect and stewardship for the watersheds' resources.

The Watershed Rangers main activities are: 1) patrol, 2) field interpretive programs, and 3) school-based programs. Watershed Rangers are assigned to one of the watersheds and report to the relevant Superintendent and to the Division Director.

Also, Watershed Rangers are responsible for the implementation of the Public Access and Recreation Management Program (with assistance from NR on planning and from Operations on signage) and for Public Education.

Qualifications and Training

Personnel assigned to the Watershed Rangers come from a wide educational background. The Watershed Rangers have participated in intensive training and professional development courses, including:

- Interpretive Training Institute;
- Project WET Training;
- State Police Academy (Facilitating Communication in Difficult Situations);
- CPR/First Aid;
- Search and Rescue; and
- Hazardous Materials Awareness.

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[2] Rangers are not responsible for criminal enforcement; when this is necessary, Rangers involve State Police.

9.1.11 MWRA Participation in Watershed Protection Activities

The Planning Department of the MWRA Waterworks Division has played a significant role in watershed management since 1989, when MWRA and MDC/DWM hired Rizzo Associates to develop the first protection plans for the Quabbin/Ware and Wachusett watersheds. MWRA staff members belong on the Land Acquisition Policy Panel, and participate in a review capacity on all major projects. MDC/DWM and MWRA have quarterly coordination meetings on a wide range of watershed operation and policy issues. There are also various task forces between the two agencies.

9.1.12 Use of Consultants

The core staff of DWM is supplemented in expertise and resources by the use of consultants and universities for special assignment or when MDC/DWM needs to add specific skills. These consultants, engineers, scientists, and other professionals perform specific studies and/or tasks under contract. **Table 9-1** lists consultant projects for the 1996-2000 period.

9.2 Budget

The annual operating budget for DWM is appropriated by the Legislature through the state budgeting process. MWRA reimburses the Commonwealth for 100% of the actual operating expenses of DWM. MWRA also reimburses the Commonwealth for all debt service on capital projects and land acquisition, and funds the PILOT program for watershed communities. Note that the DWM line item budget also contains an appropriation for payment for sewage treatment costs for the Town of Clinton, which is funded from the general fund of the Commonwealth and is separate from operating costs paid by MWRA.

The DWM operating budget has almost doubled since FY93, when the budget appropriation totaled $6.4 million, of which $5.9 million was actually spent. The DWM budget appropriation for fiscal year FY98 was $11.6 million, including $500,000 for the Clinton sewage treatment payment.

Table 9-2 shows the DWM total annual appropriations and expenditures for the fiscal years from 1995 through 2000, inclusive, and the costs broken down into four major spending categories: Personnel, Contracts, Operations, and Special (which includes payments to municipalities.

DWM personnel costs account for over 70% of the DWM operations budget. **Table 9-2** also indicates the total number of full time equivalent (FTEs) employees on the Division payroll by fiscal year. The Division increased its staff in response to expanding program needs, as well as recommendations of the 1991 Plan, rising from an FTE level of 127 in FY93 to the present level of 173. While the 1991 Plan suggested a staff level of 185 FTEs might be required to accomplish the Plan's recommended programs, the DWM managed to accomplish its objectives through a continual effort to balance in-house staff expansion with consultant services, shifting projects requiring more labor time than is available in-house, as well as specialized assignments, to consultant staff.

In addition, MWRA has several Waterworks Division staff people dedicating significant time to watershed protection planning activities and water quality monitoring. These MWRA efforts are closely coordinated with DWM.

Table 9-1
Recent Examples of MDC/DWM Projects Utilizing Consultants

Project	***Cost***	***Dates***
University of Massachusetts, Amherst (CEE)	$84,000	12/96-2/98
Microorganism Differentiation	$100,000	2/98-6/99
Transportation Release Controls Study	$140,000	1996-1998
Bioengineering Study and Design	$15,000	1996-1998
Stormwater Management Plan	$150,000	1996-98
Agricultural BMP Study	$45,000	1996-1998
HazMat Emergency Response Planning	$50,000	1996-1998
Gates Brook Treatment Feasibility	$140,000	1996-1998
Stream and Groundwater Monitoring	$35,000	Annual, beginning 1997
Gull Control	$3,500	1996, 1997, 1998
Model Subdivision Regulations	$40,000	1996-1998
Land Management Plans	$50,000	1996-1998
Land Analysis and Planning (Norco, Homestead)	$38,000	1997
Rutland Master Plan and Zoning Bylaw	$150,000	1998-2001
Technical Assistance (NRWA)	$25,000	1998
Household Hazardous Waste Removal	$70,000	1996-1998
Pilot On-Site Remediation	$150,000	1996-ongoing
North Dike Fencing	$25,000	1996-1997
Geotechnical Evaluation of Cunningham Ledge	$25,000	1996-1997
Holden, West Boylston Facilities Plan	$230,000	1992-1995
Rutland-Holden Sewer Mediation	$50,000	1996-ongoing
Model On-Site Wastewater Management District	$25,000	1996-ongoing

Source: (MDC/DWM, 1998)

Table 9-2

DWM Annual Expenditures and Full Time Equivalents (FTEs)
FY1995-FY2000

Annual DWM Expenditure	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000
Personnel	$6,369,100	$6,679,900	$7,175,700	$7,742,257	$7,714,047	$7,745,887
Contracts	$682,200	$1,039,200	$1,084,900	$1,034,257	$1,069,904	$1,171,633
Operations	$1,119,700	$1,218,600	$1,173,300	$1,226,245	$1,539,076	$1,192,528
Special	$128,000	$503,000	$500,000	$526,347	$500,000	$500,000
Total Expenditures	$8,299,000	$9,440,700	$9,933,900	$10,529,557	$10,823,027	$10,610,048
FTEs at the end of the year	151	162	161	156	165	173

Source: (MDC/DWM Progress Report, 2000)

At the end of FY99, the MDC/DWM staff included 165 full time equivalents (FTEs). On June 30, 2000, the DWM staff was 173 FTEs (including 3 Watershed Initiative Basin Team Leaders). The FY00 budget was $11,666,975; the actual fiscal year expenditures through June 30, 2000 totaled $10,365,177.

9.3 Five-Year Plan

The DWM is committed to adequate staffing for the wide variety of activities involved in protecting the water supply (see **MDC/DWM's Action Plan 2000-2005**). Since 1988, DWM staffing has steadily increased, and the DWM organization has been modified several times to meet evolving program needs. At present, DWM has a very qualified staff. Further, DWM has provided an outstanding level of support for staff in areas such as training and continuing education, computers (hardware, software, and training), laboratory equipment, vehicles, heavy equipment, etc. DWM's full implementation of the 1991 Plans is directly attributable to the capabilities of its staff.

To meet needs over the next five years, DWM proposes to fill 21 of its present vacancies and create four new positions. With the new positions filled, the total permanent staffing level will reach 190 employees. The organization chart, **Figure 9-1** presented earlier, lists the anticipated numbers of personnel in each section. Note that eight sewer positions are funded directly by the Holden-West Boylston sewer program and are considered nonpermanent positions.

With the additional hiring, expenditures in the personnel category will rise to about $8.25 million, and represent DWM's major costs. Outside costs may also increase to fund implementation of programs such as stormwater management and agriculture, to a total projected budget of $12.5 to $13.5 million.

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Appendix A - 1

DEP's Programmatic Milestones and Measures of Success vs. MDC/DWM Watershed Protection Plan Accomplishments and Activities

Item	DEP's Measures of Success for each Programmatic Milestone[1]	Status	MDC/DWM's WPP Accomplishments and Activities (Summarized)	WPP Section
1. Watershed Control – Programmatic Milestone				
Measures to Obtain Waiver:				
a.	Own most sensitive land/or control through deeded restrictions, easements, etc., or provide evidence of efforts to provide long-term protection of these lands through the enactment on adequate local bylaws, BOH regulations, rezoning, etc.	Meet	MDC/DWM owns the most sensitive lands (all shoreline). DWM owns 56.8% of the Quabbin Reservoir Watershed – excluding the reservoir's surface area – and 37% of the Ware River Watershed (Section 4.1); controls through its WsPA regulations an additional 11% of the Quabbin Reservoir Watershed and 17.5% of the Ware River Watershed – including tributary buffers (Section 5.1). Other state agencies, conservation organizations, and private parties hold another 18% of the Quabbin Reservoir Watershed and 20% of the Ware River Watershed as preserved and protected lands (Section 4.4). In addition, DWM provides extensive community technical assistance and is directly involved with local boards (Section 5.3) by providing technical support.	4.1, 4.4, 5.1, 5.3
b.	Provide criteria used to prioritize parcels for control measures (criteria to be considered, at a minimum, shall include historical, existing, or potential detrimental land uses prioritized according to risks, distance to intake, source,… etc.)	Meet	DWM continues to buy additional lands for long-term preservation. Since 1991, DWM has purchased and additional 1,343 acres in the Quabbin Reservoir Watershed and 3,031 acres in the Ware River Watershed (Section 4.1). MDC/DWM developed the Ware River Watershed Acquisition model based on the land acquisition model developed for the Wachusett Reservoir Watershed (Section 4.1).	4.1
c.	Parcels prioritized as high risk within DEP's Zones A, B, & C should be owned and/or deed controlled… The water supplier shall show successful efforts to control activities on other parcels identified with risks through ownership, deed control, or a variety of other protection options such as local regulations, bylaws, rezoning.	Meet	MDC/DWM does own the "high risk" lands, defined as the lands surrounding the reservoir and also has significant holdings along tributary buffers and throughout the watersheds (Section 4.1). MDC/DWM owned lands and other protected open space total 74% of the Quabbin Reservoir and 57% of the Ware River Watershed (Section 4.4) and these numbers continue to increase with on-going land acquisition activities. The remaining lands are privately owned, yet protected by the MDC Watershed Protection regulations (350 CMR 11.00). Local, state, and federal protection regulations also protect these watershed lands (Section 5.1).	4.1, 4.4, 5.1

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[1] MA DEP DWS (April, 1996) "Program to Measure Success of Watershed Protection Efforts Conducted by Public Surface Water Suppliers to Obtain, and Maintain a Waiver from Filtration - Draft #5" This document specifies DEP's process for assessing requests for filtration waivers and criteria – termed "programmatic measures" – to measure the success of the water supplier's watershed efforts.

Item	DEP's Measures of Success for each Programmatic Milestone[1]	Status	MDC/DWM's WPP Accomplishments and Activities (Summarized)	WPP Section
Measures to Maintain Waiver				
a.	Present evidence to DWS during annual inspection that land use protection measures which have been enacted to address HIGH, MEDIUM, LOW impact activities are working to reduce impacts (i.e., through a description of the regulatory authority's procedures for reviewing proposed developments; summary of projects approved since the last annual inspection, etc.)	Documentation available at DWM offices	DWM's implementation of the various land use controls in its Watershed Protection regulations (350 CMR 11.00) provides extensive watershed protection from certain land use activities within private lands and waters and on MDC/DWM managed lands and waters in the watersheds (Section 5.1). DWM staff specifically reviews all development activities falling within the WsPA's protection zones according to the regulations. DWM staff with local boards (e.g., Conservation Commission) to support local land use controls. DWM maintains a library of all watershed town bylaws and receives monthly updates.	5.1
b.	Provide evidence to water supplier input to local regulatory review processes.	Documentation available at DWM offices	DWM fund studies and contributes technical expertise to revise watershed town subdivision by-laws. DWM staff provide regulatory and technical input at local board meetings (e.g., BOH or Conservation Commission), as needed (Section 5.3).	5.3
c.	Provide copies of any changes in local zoning regulations affecting water supply protection to DWS during the annual on-site inspection.	Documentation available at DWM offices	DWM maintains an up-to-date library on all watershed towns' bylaws, with a focus on those related to land use activities such as subdivision/residential development and earth removal.	5.3
d.	Provide evidence that newly identified impacts have been adequately addressed through land acquisition, deed control, or other protection measures. Documentation available at DWM offices.	Documentation available at DWM offices	DWM's expansive water quality monitoring (Section 8.1) and watershed sanitary inspections (a.k.a. sanitary surveys) (Section 8.3) programs to monitor the effectiveness of the watershed protection program, existing land use controls, and to ensure that any new water quality impacts are quickly identified and remediated. DWM also conducts target monitoring aimed at assessing the effectiveness of specific protection measures.	8.1, 8.3
e.	Provide evidence that newly identified impacts have been adequately addressed through land acquisition, deed control, or other protection measures.	Documentation available at DWM offices	There are very few land use activity impacts in the Quabbin Reservoir watershed and Ware River watershed as evidenced by water quality data (Section 2.4). These are limited to roosting gulls, addressed by the gull control program (Section 4.2). DWM has various programs in place to adequately control newly identified impacts. These programs include land acquisition, where necessary to halt a significant problem (Section 4.1), as well as targeted areas such as development, public access, wildlife, agriculture, wastewater disposal, storm water, rights-of-way, contaminated site, emergency situations, construction, gravel mining (Sections 4-8).	2.4, 4.2

2. Public Access/Recreation – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Develop public access/recreation policies and plan to control public access on water supply and on water supplier owned lands; plan shall include, at minimum, provision for prohibiting bodily contact with source as required by 310 CMR 22.20(7) of the Massachusetts Drinking Water Regulations; allowed uses; mechanisms for control; provisions for regular inspections, enforcement, education, and posting of signs	Meet	DWM developed the Quabbin Reservoir and Ware River Public Access and Recreation Policy and Plan in 1988, including the required provisions. Also, DWM has promulgated and enforces it own watershed protection regulations concerning allowed, restricted, and prohibited activities on MDC/DWM lands (Section 4.3). All allowed activities have access controls (e.g., location, time of access, etc.).	4.3
b.	Identify problem use areas on water supplier-owned lands which may require more frequent inspections.	Meets	DWM Watershed Rangers provide surveillance of MDC/DWM-owned lands and waters, in both the Quabbin Reservoir watershed and Ware River watershed. Patrols emphasize the more popular access locations (Section 4.3). DWM water quality monitoring and watershed inspection surveys identify any problems on both private lands and waters as well as on MDC/DWM-owned lands and waters (Section 8.1 & 8.3).	4.1, 8.1, & 8.3
Measures to Maintain A Waiver:				
a.	Provide evidence of implementation of management plan.	Documentation available at DWM offices	DWM's current implementation of its updated Plans includes modification of allowed/restricted activities and areas (see Plans), expansion of the Watershed Ranger program, public education/outreach, installation of access barriers, and plan evaluation. Additional measures, such as improved signage (gate, trail, and informational kiosks), are underway.	4.3
b.	Provide evidence (logbook) of sufficient inspections on water supplier-owned lands to monitor public use; enforcement of rules and resolution of violations	Documentation available at DWM offices	Watershed Rangers keep daily logs of public's use and activities on DWM lands and waters. In partnership with State Police, EPOs, and local police departments. Rangers continue to enforce public access regulations. The Chief Ranger complies statistics from each ranger's logbook each month (Section 4.3).	4.3
c.	Show proper upkeep and management of water supplier-owned lands	Meet	DWM has an acclaimed forestry program, aimed at increasing forest diversity to protect long-term water quality (Section 4.2).	4.2
d.	Update public access/recreation plan as needed.	Meet	DWM updated its 1988 public access management plan for the Quabbin Reservoir Watershed System in 1998 and for the Ware River Watershed in 2000. MDC/DWM will update these plans as needed (Section 4.3).	4.3

3. Wildlife Management – Programmatic Milestone				
Milestone to Obtain A Waiver:				
a.	Conduct wildlife inventory; provide assessment of vulnerability of watershed to wildlife populations and identify impacts on source;	Meet	DWM conducts several wildlife-focused inventories within the White-tailed Deer Impact Management Program -Quabbin Reservation) (Section 4.2), Bird Harassment Program , Bird Population Controls, and Aquatic Wildlife Controls (Section 6.1). DWM Assessment of bird and mammal counts are reported annually.	4.2, 6.1
b.	Develop management plan/policies for control of existing and potential wildlife impacts	Meet	DWM's current Wildlife Management Program and updated WPP include activities in the Deer Impact, Bird Harassment, Bird Population Control, and Aquatic Wildlife Control programs (Sections 4.2 and 6.1)	4.2, 6.1
c.	Provide evidence of elimination of any existing wildlife impacts through inspection logs, wildlife counts and monitoring data	Documentation available at DWM offices	The dramatic decrease in fecal coliform bacteria levels at the Quabbin Reservoir's CVA intake with the initiation and operation of the Bird Harassment Program has been well documented (Section 2.4 & 6.1). Similarly, the dramatic increase in natural regeneration and forest diversity with the initiation of the Deer Impact Management Program has been well documented (Section 4.2). Wildlife counts are kept on file; all monitored and controlled wildlife populations have declined (Section 6.1).	2.4, 4.2, 6.1
d.	Develop and implement water quality monitoring program to assess wildlife impacts	Meet	DWM's water quality monitoring is designed to capture all potential pollution sources, including wildlife sources. Specifically, monitoring of tributaries and in-reservoir sampling within the Pathogen Control Zones, serve to identify possible wildlife impacts; in addition, research and development of emerging laboratory methods for analyses is being conducted by UMass for MDC/DWM (Section 8.1).	8.1
Measures to Maintain A Waiver:				
a.	Present evidence (logbook) of regular inspections for wildlife impacts and address/eliminate impacts as needed.	Documentation available at DWM offices	DWM's wildlife biologist maintains records of all sightings, surveys, and actions (including animal removals). (Section 6.1)	6.1
b.	Continue conducting water quality monitoring program to assess wildlife impacts.	Meet	See Item d above.	8.1
c.	Update management plan as needed.	N/A	DWM has just updated in this WPP. DWM will update its management goals, objectives, and activities as needed. (Section 6.1)	6.1
d.	No disease outbreaks associated with wildlife.	Meet	There are no known waterborne disease outbreaks associated with the Metropolitan Boston water system.	2

4. Infrastructure Improvements – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Inventory and map or summarize municipal activities and facilities in watershed.	Meet	There are no WWTP discharges in the watersheds (Section 6.3). There are no open landfills in the Quabbin Reservoir watershed or Ware River watershed. Three historic landfills in the Ware River watersheds have been closed and capped in accordance with DEP standards (Section 7.2). DWM coordinates directly with municipalities (Sections 7.1 & 5.3).	6.3, 7.2, 7.1, 5.3
b.	Identify impacts on source from municipal activities and facilities.	Meet	See item a (above).	6.3, 7.2, 7.1, 5.3
c.	Provide adequate guardrails or other safety & accident prevention barriers where a road or railroad passes over or through a public water supply or tributaries.	Meet	There are no railroads or state highways that cross the Quabbin Reservoir. DWM has and continues to work with responsible parties (e.g., MassHighway, DFA, Providence & Worcester Railroad) to ensure adequate safety measures are maintained along railroad rights-of-way and state highways crossing tributaries in the watersheds. DWM recently conducted a detailed study of additional needs on roads *near* the reservoir (Section 7.1)	7.1
d.	Develop goals and implement actions to eliminate/modify municipal activities and facilities with impacts.	Meet	See Item a. Also, DWM has recently completed the Transportation Release Controls Study which recommends specific improvements to/near state highways to minimize potential for impact. Other municipal facilities, such as salt storage sites, are now covered and one is being relocated (Section 7.1)	7.1
e.	Provide map or summary of eliminated/relocated activities and facilities.	Documentation is available at DWM offices	Three municipal landfills in the Ware River watershed have been closed and capped in accordance with DEP standards (Section 7.2). Other municipal facilities such as salt storage sites are now covered and one site is being relocated (Section 7.1).	7.2, 7.1
f.	Identify, with time-line, infrastructure maintenance/improvements related to municipal water distribution and sewer collection systems.	Meet	There are no municipal distribution and sewer collection systems in the Quabbin Reservoir watershed.	6.3
g.	Provide evidence that water supply intake and any dams are properly designed, constructed, inspected, protected, and maintained, that pump-house is secured against unauthorized entry, and that any barriers are installed, as deemed necessary by the Division of Water Supply.	Documentation available at the DWM and MWRA offices	MWRA maintains three secured intake stations – Chicopee Valley Aqueduct Intake station, the Quabbin Aqueduct Intake station, and the Ware River Intake station. DWM maintains and inspections the dams, dikes, and select bridges in the watershed system (Section 7.5).	7.5

Measures to Maintain A Waiver:				
a.	Verify no new impacts to source from municipal activities/facilities.	Meet	DWM's extensive water quality monitoring program (Section 8.1), watershed sanitary inspection program (Section 8.2), community technical assistance (Section 5.3), monitor and ensure no new impacts from municipal activities.	8.1, 8.3, 5.3
b.	Provide evidence that infrastructure maintenance and improvements are proceeding per schedule.	Documentation is available at the DWM and MWRA offices.	DWM makes regular and systematic infrastructure inspections (Section 7.5).	7.5
c.	Provide evidence of additions to schedule, as needed.	Meet	DWM will update schedules as needed (Section 7.5).	7.5
d.	Provide evidence of continued inspections, maintenance, and repairs to water supply intake and any dams, and that pump-house continues to be secured against unauthorized entry.	Documentation is available at MWRA offices.	MWRA and DWM have ongoing maintenance programs in place.	7.5

5. In-lake Problems – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Identify any problems related algae, macrophytic vegetation, bacteria, turbidity, seasonal problems, etc.; show actions to eliminate identified problems.	Meet	DWM conducts extensive water quality monitoring (Section 8.1). Quabbin Reservoir's water quality is excellent. Algae exist at low levels in the reservoir (Section 2.4). DWM monitors nutrients and NOM, as well as conducts biomonitoring, in watershed tributaries and in reservoir locations to detect seasonal fluctuations (Section 2)	8.1, 2.4, 2
b.	Provide evidence of regular inspections and water quality monitoring program to identify any new or recurring problems	Meet	DWM conducts weekly water quality monitoring at various locations in the watersheds and on the reservoir (Section 8.1). In addition, DWM conduct watershed sanitary inspections on a rotating basis (Section 8.3).	8.1, 8.3
c.	Develop action plan/procedures to address any future problems in a timely manner.	Meet	DWM's extensive programs provide staff resources and capability to respond to any future problems. For example, DWM effectively controlled the roosting birds that were previously a problem for in-reservoir bacteria (Section 6.1). Also, MWRA has capability for localized copper sulfate application to control algae in the intake.	6.1
Measures to Maintain A Waiver:				
a.	Maintain lake health; provide evidence of continued regular inspections and log of monitoring data.	Meet	DWM's water monitoring program is on-going (Section 2). DWM conducts annual planning of most programs (Section 8.1)	2, 8.1
b.	Provide evidence of addressing any new or recurring problems in a timely manner.	Meets	DWM was able to address in-lake impacts from roosting birds (Section 6.1).	6.1
c.	Adjust monitoring locations as needed.	Meets	DWM adjusts locations as needed, conducting annual planning of the monitoring program. In addition, special studies are done to supplement routine monitoring (Section 8.1).	8.1

6. Sampling – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Meet all sampling requirements outlined in 310 CMR 22.00 and in the Watershed Protection/Control Program.	Meet	MWRA conducts regulatory source water quality monitoring at the intakes in accordance with 310 CMR 22.00 and the IESWTR. DWM conducts routine regulatory water quality monitoring throughout the watersheds and reservoir (Section 8.1).	8.1
Measures to Maintain A Waiver:				
a.	Continue to meet all sampling requirements outlined in 310 CMR 22.00 and in the Watershed Protection/Control Program source sampling plan and schedule; and	Meets	MWRA and DWM water quality sampling is ongoing (Section 8.1).	8.1
b.	Show, through monitoring and trend analysis, no degradation of water quality.	Documentation is available at DWM offices.	Since DWM began extensive watershed protection program which included enhanced water quality monitoring, the data indicates that reservoir water quality has improved or stayed the same (Section 2). DWM publishes annual water quality reports to integrate the extensive data collected in the watersheds and reservoir.	
7. System Operation/Maintenance – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Provide a copy of management and operating procedures.	Documentation available at MWRA offices.	MWRA has Operation & Maintenance manuals at the CVA, Quabbin Aqueduct, and Ware River intake stations (Section 7.5).	7.5
b.	Provide a copy of adequate inspection and maintenance program for the system's equipment.	Documentation at MWRA offices.	MWRA maintains inspection and maintenance logs at the CVA, Quabbin Aqueduct, and Ware River intake stations (Section 7.5).	7.5
c.	Provide evidence of equipment repair log.	Documentation at MWRA offices.	MWRA maintains equipment repair logs (Section 7.5).	7.5
Measures to Maintain A Waiver:				
a.	Update management and operating procedures.	Documentation at MWRA offices.	MWRA updates its procedures as needed (Section 7.5).	7.5
b.	Update inspection and maintenance program as needed.	Documentation at MWRA offices.	MWRA updates its C & M program as needed (Section 7.5).	7.5
c.	Maintain repair log.	Documentation at MWRA offices.	MWRA maintains its repair log (Section 7.5).	7.5

8. Staffing – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Identify staffing needs (work to be accomplished and time needed to complete it) and evidence of sufficient staff, or a schedule for meeting staffing needs.	Meet	DWM expanded its staff significantly following the 1991 plan. Several additional positions (currently vacant or new) are planned in the 5-year period.	9
b.	Identify staffperson responsible for performing day-to-day watershed protection activities, conducting regularly scheduled inspections, and updating Watershed Resource Protection Plan.	Meet	Mr. Joseph McGinn, Esq., Director of the MDC-Division of Watershed Management, is responsible for the MDC/DWM's Watershed Protection Program and Plans. Mr. William Pula, P.E., Superintendent -Quabbin Section, is responsible for the day-to-day watershed protection activities and conducting regularly scheduled inspections. Both McGinn and Pula are responsible for updating the Watershed Protection Plan – Quabbin Reservoir Watershed and Ware River Watershed.	9
c.	Identify staff training needs and a schedule for meeting them.	Meet	DWM provides ongoing training for its staff.	9
d.	Show water supply operation and maintenance being carried out by qualified individuals per requirements.	Documentation available at MWRA offices.	MWRA operators at the Ware River, Quabbin Aqueduct, and Chicopee Valley Aqueduct Intake stations hold required certification and are well trained. DWM staff are well qualified, representing various professional degrees and certifications (Section 7.5 and 9.1).	7.5, 9.1
Measures to Maintain A Waiver:				
a.	Continue to show sufficient and qualified staff, or are on-schedule with meeting those needs.	Meets	See item a (above).	9
b.	Document that training schedule is being met.	Documentation available at DWM offices.	DWM provides ongoing training for its staff using conference seminar attendance, in-house training, and specialized training from other state agencies (e.g., DEP) (Section 9.1).	9.1
c.	Show that water supply operation and maintenance continues to be carrier out by qualified individuals.	Documentation available at MWRA offices.	See item d (above).	9
d.	Have provided water supply reference and training materials for staff use.	Meets	DWM has a large library of watershed protection and management documents. The MWRA library also serves as a reference resource for DWM staff.	9

9. Emergency Planning/Response – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Have emergency plan in effect which addresses, at minimum, response team and procedures, training, equipment, emergency communication network (including chain of command for the coordination and implementation of response actions across agency/municipal boundaries), drills.	Meet	DWM prepared an Hazardous Materials Emergency Response Study for the Quabbin Reservoir Watershed and Ware River Watershed in June 1998 (Section 7.3). This study includes coordination among watershed towns' Emergency Response Plans, equipment and training. DWM is implementing the study's recommendations.	7.3
b.	Map locations of catch basins which could discharge spilled materials into watershed of public surface water supply and distribute to emergency response personnel.	Meet	DWM has surveyed the roads near the reservoir and identified several areas of potential for spill transporting whether by overland or piped flows. DWM has conducted corrective actions to eliminate direct discharges of highway runoff into watershed tributaries (Section 7.1).	7.1
c.	Show successful completion of at least one water supply-related drill; address and correct any problems noted with procedures.	Meet	DWM staff completed an emergency response program with a related water supply related response drill in collaboration with local and state agency personnel (Section 7.3)	7.3
d.	Coordinate plan and drill with other watershed towns, if applicable.	Meet	See item c (above).	7.3
e.	Identify high impact land uses upstream and arrange for waer supplier to be included in communications network in case of a spill or other emergency situation which could affect source.	Meet	DWM has inventoried underground storage tanks (UST) – working with local fire departments during removal. DWM monitors DEP's database of hazardous materials generators and past releases. DEP and local fire departments notify DWM in case of a spill (Section 7..3).	7.3
f.	Identify, and make efforts to control, roadway hazards, vehicular routes (transporters of hazardous cargo via roads/railroads should be rerouted), municipal activities which could cause spills.	Meet	DWM prepared the Transportation Release Controls Study and is now prioritizing the recommendations and implementing strategies to reduce the risk of accident or spill (Section 7.1).	7.1
g.	Post signs at major roads in watershed and access point to water supply, noting "public surface drinking water supply".	Meet	DWM posts and maintains numerous MDC/DWM signs along property boundaries, access gates and barways, and popular stops throughout the watersheds. Additional new educational and information signs are being developed and installed (Section 4.3).	4.3

h.	Develop education program to address spill prevention issues with residents, school administrators, businesses, agricultural entities, etc.	Meet	DWM's Interpretative Services staff conduct in-school and on-site educational programs (Section 5.4). DWM's Watershed Rangers educate visitors on MDC/DWM property during their patrols. Also, various DWM personnel make watershed protection presentation to individual groups (Section 5..3).	5.4, 5.3
Measures to Maintain A Waiver:				
a.	Conduct annual water supply-related drill and provide write-up, noting problems and corrective actions (coordinate with other towns in watershed, if applicable).	Meet	See item c (above).	7.3
b.	Review and update plan annually.	Meet	DWM will update its response programs annually.	7.3
c.	Inspect watershed for conditions conducive to spills/accidents; remove or control problem where possible.	Meets	See item f (above).	7.3
d.	Maintain contact with high impact land users upstream.	Meets	See item e (above).	7.1, 7.3
e.	Maintain signs.	Meets	DWM maintains its educational and informational signs (Section 4.3)	4.3
f.	Conduct at least one emergency response-related event from educational program annually.	Meets	Education program incorporates many different elements, including spills/emergencies.	5.4

10. Education/Multi-town Coordination – Programmatic Milestone				
Measures to Obtain A Waiver:				
a.	Show efforts to develop educational programs to address water supply needs related to public relations for source, public access/recreation, wildlife/domestic animal management, support for infrastructure improvements, prevention of spills, control measures, underground storage tanks, septic systems, storm-water runoof, erosion, residential use of fertilizers, pesticides, monitoring results, etc. (develop for residents, other towns in watershed, where applicable, community groups, town officials, and staff, business and agricultural groups, schools, etc.)	Meet	DWM has several focused education efforts. Interpretative Services provide school-based education programs and interpretative programs for adults (Section 5.4). Watershed Rangers patrol, educate, and intervene throughout water-supply lands and waters (Section 4.3). DWM staff such as EQ, Planning, Natural Resources, and Forestry sections provide direct outreach to town boards, departments, and individuals. Staff give presentations to many different organizations, on request (Section 5.3). DWM staff from all sections often work one-on-one with residents, farmers, businesses, and town officials to understand the various environmental regulations and to identify and implement solutions.	5.4, 4.3, 5.3
b.	For multi-town watersheds: exchange copies of maps, local Watershed Resource Protection Plan, and any local bylaws and regulations related to water supply protection with other towns in watershed.	Meet	DWM has a complete library of local regulations (Section 5.3). Also, MDC/DWM has provided towns with various water supply maps (e.g., WsPA maps, MDC/DWM Public Access Maps) and copies of MDC's Watershed Protection regulations (Section 5.1).	5.3, 5.1
c.	For multi-town watersheds: show effort to develop a regional water supply protection committee to meet on a regular schedule to provide assistance to water supplier regarding base-line level of protection in each town, educational programs, etc.	Meet	The Water Supply Citizen's Advisory Committee (WSCAC), Quabbin Watershed Advisory Committee (QWAC), and the Ware River Watershed Advisory Committee (WRWAC) consist of representatives of the watershed communities and various user groups (e.g., ratepayers, conservation groups, recreational groups) and provide stakeholder input to DWM (Section 4.5).	4.5
d.	For multi-town watersheds: show effort to establish process for water suppliers to be notified, and provided with the opportunity to comment, about propsed projects in other watershed towns.	Meet	DWM comments on many proposed projects in the watershed area and covers Conservation Commission and Board of Health meetings in the watershed communities (Sections 5.1 and 5.3). Also, DWM receives copies of MEPA filing for larger projects in the watersheds (Section 5.2).	5.1, 5.3, 5.2

e.	For multi-town watersheds: show effort to improve watershed protection in other towns.	Meet	DWM provides significant educational, technical, and financial outreach and support to watershed town boards.	5.3
Milestone to Maintain A Waiver:				
a.	Provide evidence of implementation of educational programs, conduct at least one major educational seminar yearly.	Meet	DWM's Interpretative Services has conducted approximately 600 program for 33,000 participants since 1996.	5.4
b.	Review and update programs annually, at minimum.	Meet	DWM updates its education programs annually (Section 5.4)	5.4
c.	Provide evidence of continued exchange of maps, updated plans, and new/updated local regulations/bylaws, where applicable.	Documentation available at DWM offices.	DWM will provide updated WsPA and MDC/DWM Public Access maps to towns, individuals, and groups on request (Section 5.1 & 4.3).	5.1, 4.3
d.	Hold public forum for local officials and staff at least once per year to discuss water supply-related issues; for multi-town watersheds: invite local officials and staff from other towns also.	Meet	DWM holds annual public forums regarding its Land Management Plans (Section 4.2). DWM holds numerous public forums and public hearings, as needed. Monthly Advisory Committee meetings are open meetings for the public (Section 4.5).	4.2, 4.5
e.	Where regional water supply protection committees have been established, provide evidence of regular meetings and activities.	Documentation available at DWM offices.	WSCAC, QWAC, and WRWAC typically meet monthly at various locations in the watersheds.	4.5
f.	Where regional water supplier new project notification process has been established, provide evidence of project review.	Documentation available at DWM offices.	DWM has access to and utilizes the opportunity to comment on state and local permit applications (Section 5.2 & 5.3).	5.2, 5.3

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WATERSHED PROTECTION REGULATIONS
350 CMR 11.00
Division of Watershed Management, Metropolitan District Commission

Section

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11.01: Introduction and Purpose

(1) Introduction - 350 CMR 11.00 is promulgated by the Commissioners of the Metropolitan District Commission pursuant to the authority granted under St. 1992 c. 36. St. 1992 c. 36, § 2 amends M.G.L. c. 92, § 104 by adding certain definitions which are used in 350 CMR 11.03; St. 1992 c. 36, § 3 adds M.G.L. c. 92, § 107A defining the jurisdiction and exemptions contained in 350 CMR 11.04 and 350 CMR 11.05, respectively; and St. 1992 c. 36, § 4 amends M.G.L. c. 92, § 108 by requiring the Division of Watershed Management, after consultation with the Department of Environmental Protection, to make rules and regulations for the protection of Watersheds as defined in St. 1992 c. 36.

In addition, St. 1992 c. 36 and M.G.L. c. 92 authorize the Metropolitan District Commission and the Division of Watershed Management to make rules and regulations to protect the Watersheds as defined in St. 1992 c. 36 and the Watershed System as defined in St. 1992 c. 36 and M.G.L. c. 92. The Department of Environmental Protection is also required under St. 1992 c. 36, § 14 to adopt rules and regulations for the prevention of pollution and securing the sanitary protection of all waters used as sources of water supply in the Commonwealth other than in the Watersheds as defined in St. 1992 c. 36. Regulations currently exist for: (a) the sanitary protection of waters used by the Metropolitan District Commission (310 CMR 23.00); (b) land within Watershed Reservations (350 CMR 8.00); (c) sanitary rules and regulations for the Metropolitan Water Supply (350 CMR 9.00); and (d) fishing in Wachusett and Sudbury Reservoirs (350 CMR 10.00).

In order to facilitate review of all regulations promulgated by the Metropolitan District Commission and the Division of Watershed Management relating to Watersheds and the Watershed System, 350 CMR 11.09 includes regulations of general applicability to Waters of the Watershed System. The regulations in 350 CMR 11.09 are intended to

supersede the regulations in 310 CMR 23.00, 350 CMR 8.01, 350 CMR 9.00, and 350 CMR 10.00, which shall be repealed on March 31, 1994.

(2) Purpose - The purpose of St. 1992 c. 36 is to improve the protection of the metropolitan water supply. St. 1992 c. 36 and 350 CMR 11.00 set forth a comprehensive scheme to regulate land use and activities within certain critical areas of the Watersheds and Watershed System.

The purpose of 350 CMR 11.00 is to define and clarify the restrictions and prohibitions set forth in St. 1992 c. 36 by establishing standard definitions and procedures under which the Division of Watershed Management may carry out its responsibilities under St. 1992 c. 36. 350 CMR 11.00 shall complement St. 1992 c. 36 and shall have the force of law on March 31, 1994.

11.02: General Provisions

(1) Time Periods. Unless otherwise specifically provided in St. 1992 c. 36 or 350 CMR 11.00, computation of any time period referred to in 350 CMR 11.00 shall begin with the first day following the action which initiates the running of the time period. The last day of the time period so computed is to be included unless it is a Saturday, Sunday or legal holiday or any other day on which the office of the Division is closed, in which event the period shall run until the end of the next following business day. When the time period is less than seven days, intervening days when the Division is closed shall be excluded in the computation.

(2) Timely Filing. All Papers must be filed at the Division office or such other place as the Division shall specify in 350 CMR 11.00 within the time limits set forth herein.

Unless otherwise specifically provided in St. 1992 c. 36 or 350 CMR 11.00, Papers filed in the following manner shall be deemed to be filed as set forth herein:

(a) *Hand delivery during business hours*. By hand delivery during business hours shall be deemed filed on the day delivered.

(b) *Hand delivery during non-business hours*. By hand delivery at times other than during regular business hours shall be deemed filed on the next regular business day.

(c) *Mailing*. By placing in the United States Mail certified or registered mail, return receipt requested shall be deemed filed on the date received by the Division.

All Papers shall show the date received by the Division and the Division shall cooperate in giving date receipts to Persons filing Papers by hand delivery.

(3) Actions by the Division. Where St. 1992 c. 36 states that a particular action (except receipt of a request or notice) is to be taken by the Division, that action is to be taken by the person designated by 350 CMR 11.00 or, if by a committee, by more than half the members present at a meeting of at least a quorum. A quorum is defined as a Majority of the members then in office.

(4) Burden of Proof. Any Person who files a request for Advisory Ruling, a request for Watershed determination of applicability, an application for variance or a request for

Exemption of a Tributary shall have the burden of producing credible evidence from a competent source in order to demonstrate to the Division or, in the case of an appeal, to the Commission, support for the position taken or the relief requested.

(5) Capitalized Terms. Any capitalized terms used in 350 CMR 11.00 shall have the meanings ascribed to such terms in 350 CMR 11.03.

11.03: Definitions

Advisory Ruling means a ruling issued by the Division pursuant to 350 CMR 11.06(1).

Agriculture, Land in Agricultural Use and Normal Maintenance or Improvement of Land in Agricultural Use shall have the meanings ascribed to such terms in 310 CMR 10.04.

Alteration means:

(a) draining, dumping, dredging, damming, discharging, excavating, filling or grading;

(b) the erection, reconstruction or substantial expansion of any buildings or Structures;

(c) the driving of pilings;

(d) the construction or reconstruction or paving of roads and other ways;

(e) the construction or reconstruction of utilities;

(f) the changing of run-off characteristics;

(g) the intercepting or diverting of ground waters, surface waters, reservoirs, tributaries, or aquifers; and

(h) the installation or substantial expansion of drainage, sewage and water systems.

Applicability Decision means the written decision issued by the Division pursuant to 350 CMR 11.06(2)(e).

Aquifer means a geological formation, group of formations, or part of a formation in the Wachusett Watershed that is capable of yielding a significant amount of water to a well or spring, as determined by reference to the Maps, 350 CMR 11.07. The land directly overlaying an aquifer shall be deemed to be part of said aquifer.

Authority means the Massachusetts Water Resources Authority.

Bank means the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a Bordering Vegetated Wetland and adjacent Flood plain, or in the absence of these, it occurs between a water body and an upland. A bank may be partially or totally vegetated or may be comprised of exposed soil, gravel or stone. The upper boundary of a bank is the first observable break in the slope or the mean

annual flood level, whichever is lower. The lower boundary of a bank is the mean annual low flow level.

Bordering Vegetated Wetland means a wet meadow, except meadows used for the grazing of livestock, marsh, swamp, bog or other area, hydrologically connected to and bordering on a Tributary, Reservoir, Flood plain, or Surface Water, which supports at least 50% wetland species and as defined in the Wetlands Protection Act as defined herein.

Commission means the Metropolitan District Commission.

Commonwealth means the Commonwealth of Massachusetts.

Date of Issuance means the date a determination, order or decision is hand delivered or mailed as provided in 350 CMR 11.00.

Date of Submission means the date the Division assigns a file number to a request or application submitted pursuant to 350 CMR 11.06. Assignment of a file number shall not imply that a request, application or supporting documents have been determined adequate to support the relief requested, but only that the submission is complete in accordance with the requirements of 350 CMR 11.06.

Department means the Department of Environmental Protection of the Commonwealth of Massachusetts.

Discharge or Discharge of Pollutant means any addition of Pollutants or combination of Pollutants from any source including, but not limited to, discharges from surface runoff, which are collected or channelled by man and through pipes, sewers or other conveyances.

Disposal means the discharge, deposit, injection, dumping, spilling, leaking, incineration or placing into or on any land or water so that the matter disposed of may enter the environment or be emitted into the air or discharged into any waters, including Ground water.

Division means the Division of Watershed Management of the Commission.

Dwelling means any structure or building, or any portion thereof which is used, intended to be used, or designed to be occupied for human habitation purposes, including, but not limited to, houses, hotels, motels, apartments and condominiums.

Exemption Decision means a decision of the Division, in consultation with the Department, to exempt a Tributary from regulation under St. 1992 c. 36 issued pursuant to 350 CMR 11.06(4)(g).

Flood plain means the land adjoining a Tributary, Reservoir or Surface Water, which is subject to inundation from a flood having a 1% chance of being equalled or exceeded in any given year, commonly known as the 100 year flood plain, as determined by reference to the Maps, 350 CMR 11.07.

Generate or Generation of Pollutants means the origination, creation or production of Pollutants.

Ground water means water below the land surface in a saturated zone, including perched ground water.

Hazardous Material or Waste means any material or waste, in whatever form, which because of its quantity, concentration, corrosivity, flammability, reactivity, toxicity, or infectious, chemical or radioactive characteristics, either separately or in combination with any substance or substances, constitutes a present or potential threat to human health, safety, welfare, or to the environment. Hazardous Material or Waste shall include those materials listed in 40 CFR 261, or 310 CMR 40.900 Appendix I.

Impervious means not allowing entrance or passage of water due to the presence on or above the ground of material having a percolation rate of greater than 30 minutes per inch, including, but not limited to, pavement, concrete, stone, peat, loam and other organic matter.

Leaching Field means a soil absorption system as such term is defined in Title 5 (350 CMR 15.00).

List of Affected Parcels means the list developed by the Division from maps prepared pursuant to M.G.L. c. 92 § 107A(q).

Lot means an area of land subject to St. 1992 c. 36 in one ownership with definite boundaries described in a deed or shown on a plan recorded in the registry of deeds or registered in the registry district of the land court.

Maps means the maps described in 350 CMR 11.07.

Majority means more than half of the members of any body making a decision pursuant to 350 CMR 11.00.

Natural Basin means an area bounded peripherally by a water parting and draining ultimately to a particular water course or body of water; the catchment area or drainage basin from within which the waters of a stream or stream system are drawn.

Owning an Interest in Real Property or Real Property Interest means having alone, or jointly or severally with others:

(a) legal title to real property;

(b) the care, charge or control of real property in any capacity including, but not limited to as agent, executor, executrix, administrator, administratrix, trustee, or guardian of the estate of the holder of legal title;

(c) lessee under a written lease; or

(d) an agent, trustee or other person appointed by the Courts of the Commonwealth.

Papers means all requests, documents, papers, notices, appeals and other written communications permitted or required by the regulations to be filed with the Division or the Commission.

Party Aggrieved means any Person who, because of an act or failure to act by the Division or the Commission under St. 1992 c. 36 or 350 CMR 11.00, may suffer an injury in fact which is different, either in kind or magnitude, from that suffered by the general public, and which is within the scope of the interests identified in St. 1992 c. 36. Such party must specify, in writing, sufficient facts to allow the Division or the Commission to determine whether or not the party is, in fact, aggrieved.

Person means an individual, partnership, corporation, firm, association or group, including a city, town, county, the Commonwealth or other governmental unit owning property or carrying on an activity regulated by St. 1992 c. 36.

Plans means such data, maps, engineering drawings, calculations, specifications, schedules and other materials, if any, deemed necessary by the Division to describe the Lot, portion of the Lot or the Alteration to determine the applicability of St. 1992 c. 36 or to determine the impact of the Alteration upon the interests identified in St. 1992 c. 36.

Pollutant means any substance, man-made or resulting from human activities, that can alter the biological, chemical, physical, or radiological character of water.

Reservoir means either the Wachusett or the Quabbin Reservoir.

Sewage Treatment Facility means any wastewater treatment facility used for treating, neutralizing or stabilizing sewage, including: treatment or disposal plants; the necessary intercepting outfall and outlet sewers; pumping stations integral to such facilities; and equipment and appurtenances related to the foregoing.

Sewer System means pipelines or conduits, pumping stations, force mains, and all other structures, devices, appurtenances, and facilities used for collecting and conveying wastes to a site or works for treatment or disposal.

Storage means the actual or intended containment on a temporary basis or permanent basis which does not constitute Disposal.

Structure means a combination of materials assembled at a fixed location to give support or shelter, such as, but not limited to, a Dwelling, a building, framework, retaining wall, tent, reviewing stand, platform, bin, fence over six feet high, sign, flagpole, recreational tramway, mast for radio antenna or the like. The word "structure" shall be construed, where the context requires, as though followed by the words "or part or parts thereof."

Subsurface Waste Water Disposal System means an on-site subsurface sewage disposal system as defined in Title 5 (310 CMR 15.00).

Surface Water(s) means water in the Watersheds, including any lake, spring, impoundment, and pond, as determined by reference to the Maps, 350 CMR 11.07. Surface water shall include the land located thereunder and the Banks thereto. Surface water shall

exclude all Reservoirs, Tributaries, Aquifers, Ground waters, and man-made farm ponds used for irrigation, as well as so-called great ponds of the Commonwealth which do not drain into a Tributary or a Reservoir.

Title 5 means Title 5 of the Massachusetts Environmental Code governing standard requirements for the siting, constructing, repair, replacement and maintenance of on-site sewage treatment and disposal systems, 310 CMR 15.00.

Treatment means any method, technique, or process, including neutralization, incineration, stabilization or solidification, designed to change the physical, chemical or biological character or composition of any Hazardous Material or Waste so as to neutralize such Material or Waste or so as to render such Material or Waste less hazardous, non-hazardous, safer to transport, amenable to storage, or reduced in volume, except such method or technique as may be included as an integral part of a manufacturing process at the point of generation.

Tributary means a body of running water, including a river, stream, brook and creek, which moves in a definite channel in the ground due to a hydraulic gradient and which flows ultimately into a Reservoir in the Watersheds or the Ware River above the Ware River intake, as determined by reference to the Maps, 350 CMR 11.07. A Tributary shall include the land over which the water therein runs and the Banks thereto.

Uses and Activities means those uses and activities described in M.G.L. c. 92, § 107A(a) and (b)(2) and 350 CMR 11.04(3).

Variance Decision means the written decision issued by the Division pursuant to 350 CMR 11.06(3)(g).

Waters of the Watershed System means all waters that in their natural course would flow into the Ware River above the Colbrook Diversion, the open channel of the Wachusett Aqueduct, the Quabbin, Wachusett, Sudbury and Foss reservoirs and any other lake, pond, reservoir, aqueduct, stream, ditch, watercourse or any other open water under the provision of M.G.L. c. 92, § 109.

Watershed Reservation(s) means land within the Watershed System and described in St. 1972 c. 737 as amended by St. 1990 c. 436.

Watershed(s) means the Natural Basin from within which water drains or in the natural course would drain into the Quabbin Reservoir, the Wachusett Reservoir, or the Ware River upstream of the Ware River intake.
Watershed System means:

(a) all real and personal property interests held by or on behalf of the Commonwealth immediately prior to the effective date of St. 1992 c. 36 in and for the Metropolitan District Commission water system which were part of or appurtenant to the Quabbin Watershed, Quabbin Reservoir, Ware River Watershed, Wachusett Watershed, Wachusett Reservoir, North and South Sudbury watersheds, Sudbury Reservoir, Framingham Reservoirs 1, 2 and 3, Blue Hills Reservoir, Bear Hill Reservoir, Spot Pond Reservoir, Fells Reservoir, Weston Reservoir, Norumbega Reservoir, Chestnut Hill Reservoir, including land,

easements, buildings, Structures, all equipment, machinery, vehicles and appliances, improvements, water rights and rights in source of water supply; and

(b) all enlargements and additions to the former Metropolitan District Commission water system acquired or constructed by the Division for the purpose of the Watershed System, including land, easements, buildings, Structures, equipment, machinery, vehicles, and appliances, improvements, reservoirs, dams, water rights and rights in sources of water supply, but excluding the Waterworks System of the Authority.

Waterworks System means waterworks system as defined in M.G.L. c. 92 App. and 360 CMR 10.00 et seq..

Wetlands Protection Act means the Wetlands Protection Act, M.G.L. c. 131, § 40 and regulations promulgated pursuant thereto, 310 CMR 10.00 et seq.

11.04: Jurisdiction

(1) *Areas Regulated*. Areas regulated by St. 1992 c. 36 and 350 CMR 11.00 include those portions of the Watersheds which lie:

(a) within 400 feet of the Bank of a Reservoir;

(b) within 200 feet of the Bank of a Tributary or Surface Waters;

(c) within the area between 200 and 400 feet of the Bank of a Tributary or Surface Waters;

(d) within the Flood plain of a Tributary or Surface Waters, including that flood plain;

(e) within Bordering Vegetated Wetlands that border on Tributaries or Surface Waters or Reservoirs;

(f) within land that overlays an Aquifer with a potential well yield of 100 gallons per minute or more as determined in accordance with St. 1992 c. 36 and 350 CMR 11.00; or

(g) within land that overlays an Aquifer with a potential well yield of one or more but less than 100 gallons per minute pursuant to a finding by the Division, in consultation with the Department, that regulation of said Aquifer is necessary for the protection of the quality of the water in the Surface Waters, Aquifers, Reservoirs or Tributaries.

(2) *Presumptions - Properties Identified in the List of Affected Parcels*. For purposes of 350 CMR 11.00, all properties identified in the List of Affected Parcels shall be presumed to be in an area regulated under 350 CMR 11.04(1)(a) through (g). Any property which is not

identified in the List of Affected Parcels shall be presumed not to be in an area regulated under 350 CMR 11.04(1)(a) through (f).

(3) *Uses and Activities Regulated or Prohibited*.

(a) Any Alteration, or the Generation, Storage, Disposal or Discharge of Pollutants is prohibited within those portions of the Watershed that lie:

1. within 400 feet of the Bank of a Reservoir (350 CMR 11.04(1)(a)); or

2. within 200 feet of the Bank of a Tributary or Surface Waters (350 CMR 11.04(1)(b)).

(b) 1. Within those portions of the Watershed that lie:

a. within the area between 200 and 400 feet of the Bank of a Tributary or Surface Water (350 CMR 11.04(1)(c));

b. within the Flood plain of a Tributary or Surface Water (350 CMR 11.04(1)(d));

c. within Bordering Vegetated Wetlands that border on Tributaries or Surface Waters or Reservoirs (350 CMR 11.04(1)(e));

d. within land that overlays an Aquifer with a potential well yield of 100 gallons per minute or more as determined in accordance with St. 1992 c. 36 and 350 CMR 11.00 (350 CMR 11.04(1)(f)); or

e. within land that overlays an Aquifer with a potential well yield of one or more but less than 100 gallons per minute, pursuant to a finding by the Division, in consultation with the Department, that regulation of said Aquifer is necessary for the protection of the quality of the water in the Surface Waters, Aquifers, Reservoirs or Tributaries (350 CMR 11.04(1)(g)),

2. the following uses are prohibited:

a. the Disposal of Pollutants from either privately or publicly owned Sewage Treatment Facilities;

b. the placement of the Leaching Field of a Subsurface Waste Water Disposal System less than four feet above the maximum water table level as measured at the time of annual high water;

c. the storage of liquid petroleum products of any kind; provided, however, that an end user of such product, such as a resident in connection with normal residential use or a person responsible for supplying heat to a residence, may store a reasonable volume of such material so long as such storage is in a free standing container inside of the Structure, which Structure shall include at a minimum a foundation thereof with a poured cement slab floor or a concrete reservoir of sufficient volume to hold 125 percent of the tank's capacity;

d. the Treatment, Disposal, use, generation or Storage of Hazardous Material or Waste, except a reasonable volume of Hazardous Material or Waste incidental to normal residential use;

e. the Storage and the Disposal of solid waste other than a reasonable volume incidental to normal residential use;

f. the outdoor Storage of road salt or other de-icing chemicals; provided, however, that 350 CMR 11.00 shall not prohibit the outdoor Storage of sand, gravel or materials used in road construction which are not Hazardous Materials or Waste;

g. the outdoor Storage of fertilizers, herbicides and pesticides;

h. the use or Storage of pesticides or herbicides which carry a mobility rating as provided for by the United States Environmental Protection Agency or which have been determined by the Commonwealth using United States Environmental Protection Agency standards to pose a threat or potential threat to Ground water;

i. the outdoor, uncovered Storage of manure;

j. the servicing, washing or repairing of boats or motor vehicles other than as reasonably incidental to normal residential use;

k. the operation of junk and salvage yards;

l. the rendering Impervious of more than ten percent of any Lot or 2,500 square feet, whichever is greater;

m. the excavation of gravel and sand to a depth greater than six feet above the maximum water table, except where incidental to the construction of permitted Structures;

n. the Alteration of Bordering Vegetated Wetlands;

o. any other activity which could degrade the quality of the water in the Watersheds as determined by the Division after consultation with the Department; provided, however, that de-icing may be performed on a roadway under procedures approved by the Commonwealth's Secretary of Environmental Affairs; or

p. the construction of any Dwelling which exceeds a density of two bedrooms per acre or any use which may generate more than 220 gallons of sanitary sewage per acre per day.

(c) In addition to, and without limiting, the prohibitions contained in 350 CMR 11.04(3)(a) and (3)(b), within those portions of the Watersheds which overlay Aquifers with potential well yields of between 100 and 300 gallons per minute as

determined by the Division, or land whose regulation has been determined to be necessary for the protection of the quality of the water in the Surface Waters, Aquifers, Reservoirs and Tributaries, pursuant to 350 CMR 11.04(1)(g), the construction of any Dwelling which exceeds a density of one and one-third bedrooms per acre and any use which may generate more than 147 gallons of sanitary sewage per acre per day are prohibited.

(d) In addition to, and without limiting, the prohibitions contained in 350 CMR 11.04(3)(a), (3)(b) and (3)(c), within those portions of the Watersheds that overlay Aquifers with potential well yields of over 300 gallons per minute as determined by the Division, the construction of any Dwelling which exceeds a density of one bedroom per acre and any use which may generate more than 110 gallons of sanitary sewage per acre per day are prohibited.

(e) In making the calculation required under 350 CMR 11.04(3)(b)2.l. all contiguous real property within an area described in 350 CMR 11.04(1) owned by the same Person shall be used, in the aggregate; provided, however, that said area may be so used in making such calculation for only one Lot.

(f) In making the calculation required under 350 CMR 11.04(3)(b)2.p., all contiguous real property within an area described in 350 CMR 11.04(1) owned by the same Person shall be used, in the aggregate, to determine the total acreage for density purposes; provided, however, that said area may be so used for determining area density for only one Lot.

11.05: Exemptions

The provisions of 350 CMR 11.04 shall not apply to the following:

(1) *Uses, Structures or Facilities in Existence*. Uses, Structures or facilities lawfully in existence or for which all applicable municipal, state and federal permits and approvals, other than building permits and permits for septic systems, were obtained prior to July 1, 1992;

(2) *Reconstruction, Extension or Structural Change*. Any reconstruction, extension or structural change to any Structure lawfully in existence on July 1, 1992, provided that such reconstruction, extension or structural change:

(a) does not constitute a substantial change to or enlargement of that lawfully existing Structure; and

(b) does not degrade the quality of the water in the Watershed;

(3) *Lot in Existence*. The construction of one single-family Dwelling on any Lot existing as such prior to July 1, 1992, or the division of an owner occupied Lot existing as such as of July 1, 1992 into one additional Lot for a single family dwelling; provided that, wherever possible, there shall be no Alterations within the areas described in 350 CMR 11.04(1)(a) and 11.04(1)(b);

(4) *Construction - Sewer System*. The construction of any Dwelling described in 350 CMR 11.04(3)(b)2.p., 11.04(3)(c) or 11.04(3)(d) if a Sewer System existed prior to July 1, 1992 to which a direct connection shall be made without expansion of capacity and said connection is used for all sanitary sewage of any Dwelling or other Structure resulting from said construction;

(5) *Tributaries*. Tributaries, or portions thereof, which the Division, in consultation with the Department, has exempted pursuant to 350 CMR 11.00, upon a determination that such exemption will pose no significant risk to the quality of the water, after taking into account the rate of flow, slope, soil characteristics, proximity to a Reservoir or the Ware River above the Ware River intake, the current level of water quality and the current degree of development;

(6) *Work of the Division*. The Division, in the performance of its responsibilities and duties to protect the quality of the water in the Watersheds, or the Authority in the performance of its responsibilities and duties to maintain, operate and improve the Waterworks System;

(7) *Conversion of Land for Agricultural Use*. Conversion of Land for Agricultural Use or preparation of Land for Agricultural Use; provided, however, that such conversion shall be made under a plan approved by the United States Department of Agriculture, Soil Conservation Service and the Commission, in consultation with the Commonwealth's Department of Food and Agriculture;

(8) *Maintenance of Public Roadways in Existence*. The maintenance, repair, replacement or reconstruction of public roadways existing as of September 1, 1989 or railroad track and rail bed existing as of September 1, 1990, including associated drainage systems, that are necessary to preserve or restore the facility's serviceability for the number of travel lanes and uses existing as of September 1, 1990; provided, however, that in the case of any replacement the design is substantially the functional equivalent of, and is of similar alignments to that which is being replaced; provided, further, that design plans and specifications for said work on roadways, or railroad track and rail beds are provided to the Division prior to the work's commencement;

(9) *Maintenance or Improvement - Agricultural*. Activities relating to normal maintenance or improvement of Land in Agricultural Use; provided, however, that such activities do not impair the quality of the water;

(10) *Construction of Public Highways*. The construction of public highways, railroad track and rail beds and facilities directly related to their operation; provided, that the Commonwealth's Secretary of Environmental Affairs has determined that such highway or transportation service construction project requires direct access to or location in the lands described in 350 CMR 11.04(1) to avoid or minimize damages to the environment and that said Secretary and the Division have determined that such construction does not materially impair the quality of the water in the Watersheds;

(11) *Maintenance of Public Utilities*. The maintenance, repair or expansion of lawfully located Structures or facilities used in the service of the public to provide electric, gas, water, sewer, telephone, telegraph and other telecommunication services; provided, however, that such maintenance, repair or expansion activities, Structures, or facilities do

not materially impair the quality of water in the Watersheds as determined by the Division after consultation with the Department;

(12) *Maintenance of Public Utilities - Wetlands*. The maintenance, repair or replacement, but not the substantial changing or enlargement of, an existing and lawfully located Structure or facility used in the service of the public and used to provide electric, gas, water, sewer, telephone, telegraph and other telecommunication services in Bordering Vegetated Wetlands; provided, however, that such maintenance and repair activities do not materially impair the quality of water in the Watersheds;

(13) *Clean up or Prevention of Releases*. The undertaking by any Person, municipality, the United States government or the Commonwealth of temporary operations to clean up, prevent or mitigate releases of Hazardous Material or Waste;

(14) *Changes in Agricultural Crops Produced*. Changes in agricultural crops produced;

(15) *Agricultural Technologies*. The use of new or existing agricultural technologies that do not degrade the quality of water in the Watersheds more than the present agricultural technologies that such new or existing agricultural technologies replace; and

(16) *Municipal Sewage Treatment Facility or Water System*. The construction of a new municipal Sewage Treatment Facility or new municipal water system if the Division determines that water quality will not be adversely impacted from said construction and provided that such new systems comply with all existing regulations and standards applicable to water pollution abatement districts.

11.06: Procedures

(1) Advisory Rulings

(a) *Request for Advisory Ruling*. Any person Owning an Interest in Real Property may, by written request to the Division at the addresses specified in 350 CMR 11.11 by certified mail or hand delivery, request an Advisory Ruling as to:

1. whether such Person's property is located within an area regulated by St. 1992 c. 36 or 350 CMR 11.00; or

2. whether existing or proposed Structures, Uses or Activities on such Person's property are permitted under St. 1992 c. 36 or 350 CMR 11.00 by virtue of the exemptions set forth in 350 CMR 11.05.

(b) *Information Required*. Such written request shall identify the property by street address and include:

1. a copy of the current Assessor's Map showing the location of the property or reference to the applicable Assessor's Map by sheet and parcel number;

2. a copy of (or reference to) the most recent edition of the Massachusetts Geographic Information System map based on the United States

Geological Survey, 1 to 25,000 scale, quadrangle maps, showing the location of the property;

3. a copy of such Owner's deed as recorded in the applicable registry of deeds; and

4. copies of any plans, mortgage inspection plans and tape surveys of the property which are available.

(c) *Issuance of Advisory Ruling.* Within 30 days of the Date of Submission of a request for Advisory Ruling, the Division may issue a written ruling to the Person who submitted the request, or in its sole discretion, the Division may notify such Person that a request for Watershed determination of applicability is required pursuant to 350 CMR 11.06(2).

(d) *Remedy.* The Person to whom an Advisory Ruling is issued shall have no right to appeal such ruling, but may at such Person's election, submit a request for Watershed determination of applicability or an application for variance in accordance with 350 CMR 11.00. A Person who has not been issued an Advisory Ruling within 30 days may, at such Person's election, resubmit the request, or submit a request for Watershed Determination of Applicability or an application for variance in accordance with 350 CMR 11.06.

(e) *Authorization; limitations.* Any Advisory Ruling hereunder shall be issued by the Division pursuant to and subject to the limitations of M.G.L. c. 30A, § 8.

(2) Requests for Watershed Determinations of Applicability

(a) *Filing.* Any Person Owning an Interest in Real Property who desires a determination as to whether or not:

1. such Person's property is located within an area regulated by St. 1992 c. 36 or 350 CMR 11.00;

2. proposed Structures, Uses or Activities on such Person's property are permitted under St. 1992 c. 36 or 350 CMR 11.00;

3. a reconstruction, extension or structural change constitutes a substantial change or enlargement or one which will degrade the quality of water under 350 CMR 11.05(2);

4. Alterations within areas described in 350 CMR 11.04(1)(a) and 11.04(1)(b) in connection with construction permitted under 350 CMR 11.05(3) are possible;

5. the maintenance, repair or replacement activities described in 350 CMR 11.05(9), (10) or (11) will impair or materially impair the quality of the water in the Watersheds; or

6. a new municipal Sewage Treatment Facility or new municipal water system will have an adverse impact on water quality under 350 CMR 11.05(16),

may submit to the superintendent of the Reservoir of the Watershed in which such property is located at the address specified in 350 CMR 11.11, by certified mail or hand delivery, a request for Watershed determination of applicability (See 350 CMR 11.13).

(b) *Land Surveyor Determination.* Any request for Determination under 350 CMR 11.06(2)(a)1. shall be accompanied by a written determination of a land surveyor registered with the board of registration of professional engineers and land surveyors of the Commonwealth as to whether such Person's real property interests are located within areas regulated by St. 1992 c. 36.

(c) *Related Statement.* Requests for Watershed Determinations other than those in 350 CMR 11.06(2)(a)1. shall include a detailed description of the Structures, Uses and Activities which are proposed.

(d) *Additional Materials.* All surveys and additional materials or studies required to make a determination, whether or not requested by the Division, shall be prepared and delivered at the sole cost of the Person desiring the determination.

(e) *Issuance of Applicability Decision.* Within 60 days of the Date of Submission of such request for Watershed Determination, the Division shall issue a written Applicability Decision to the Person who submitted such request, in form suitable for recording in the registry of deeds or registration in the registry district of the land court where the property is located (See 350 CMR 11.13), which shall contain a brief statement of the reasons for the Decision. If the Division fails to issue the Applicability Decision within such 60 day period, the Division shall be deemed to have:

1. concurred with the land surveyor's determination set forth in a request for Determination under 350 CMR 11.06(2)(a)1.; or

2. determined that the proposed Structures, Uses and Activities on such Person's property described in the request for Determination are permitted by St. 1992 c. 36 and 350 CMR 11.00; or

3. determined that such Structures, Uses and Activities will not impair or materially impair the quality of water in the Watersheds.

(f) *Appeal.* A Person to whom the Division's Applicability Decision has been issued, who seeks to appeal such Decision, shall file a Notice of Claim for an Adjudicatory Proceeding with the Commission at the address specified in 350 CMR 11.11 within 21 days from the Date of Issuance of the Decision by the Division. The procedures for appeal before the Commission shall be as set forth in 801 CMR 1.00 et seq. At the time of filing of such Notice of Claim, a copy shall also be filed with the Division.

(3) Variances

(a) *Variances.* The Division may grant a variance from the provisions of St. 1992 c. 36 and 350 CMR 11.00 with respect to particular Structures, Uses and Activities, and shall grant, upon request, a variance with respect to crossings of Tributaries and Bordering Vegetated Wetlands, where the Division specifically finds that

owing to circumstances relating to the soil conditions, slope, or topography of the land affected by such Structures, Uses or Activities, desirable relief may be granted without substantial detriment to the public good and without impairing the quality of water in the Watersheds.

(b) *Presumptions and Standards for Required Findings.*

1. There shall be a presumption that granting a variance from the applicability of St. 1992 c. 36 and 350 CMR 11.00 to specific Structures, Uses and Activities is contrary to the achievement of the purpose of St. 1992 c. 36. This presumption may be rebutted only by the submission of credible evidence by the Person submitting the application for variance to establish that such variance may be granted without substantial detriment to the public good and without impairment of water quality in the Watersheds.

2. The standard of substantial detriment to the public good shall mean a factual determination by the Division of the overall effect of the proposed Structure, Use or Activity at a particular location in relation to the purpose of St. 1992 c. 36.

3. The standard of impairment of water quality shall mean:
a. the risk of water quality impairment presented by Structures, Uses and Activities which are permissible under all other relevant federal, state and local laws, but would not be permissible under 350 CMR 11.00 without a variance; and
b. the cumulative risk of water quality impairment from all Structures, Uses and Activities allowed under current regulations over time.

(c) *Applications.* Any Person Owning an Interest in Real Property may make an application for variance to the Division (See 350 CMR 11.13) by filing the same by certified mail or hand delivery with the Division at the address specified in 350 CMR 11.11. A copy of the application for Variance shall be sent to the Department at the address specified in 350 CMR 11.11.

(d) *Detailed Statement.* The application for variance shall include a detailed description of the Structures, Uses and Activities proposed on such Person's property. The application for variance shall include detailed information regarding each specifically enumerated factor stated in 350 CMR 11.06(3)(a). Detailed information regarding each factor shall be provided as follows:

1. *Soil Conditions.* A map prepared at a minimum scale of 1"=100' indicating the soil types as mapped by the USDA Soil Conservation Service ("SCS") shall be provided. Site specific soils data, including borings, test pits and percolation tests, may be submitted including copies of all field logs, notes, observations, conclusions and test methods employed. A detailed analysis of the soil characteristics of erodibility and permeability shall be provided. Permeability should be described in terms of

percolation rate measured as minutes per inch as specified in Title 5 (310 CMR 15.00).

2. *Slope*. Calculations of the ground slope at all lands within the areas that would be subject to St. 1992 c. 36 if the variance were not granted shall be provided. The results of such calculations shall be presented graphically on a map prepared at a scale of 1"=100' or larger, expressed as percent slope. Where applicable, the average slope of a Tributary measured as the change in elevation divided by the distance in stream miles from the upstream point of the Tributary at or near such Person's property to the downstream point of the Tributary at or near such Person's property shall also be stated.

3. *Topography*. A topographical plan at a minimum scale of 1"=100' or larger showing contour elevations at two foot intervals shall be submitted. Said plan shall be prepared and stamped by a professional surveyor or engineer registered in the Commonwealth of Massachusetts and shall show the location of all areas which would be subject to St. 1992 c. 36 if the variance were not granted. The plan shall show the location of all Ground water, soil and percolation test locations. Such topographic information as depth to the maximum annual high Ground water table, depth to ledge or refusal, and distances from all mapped and unmapped streams, ponds and water bodies shall also be provided.

4. *Water Quality*. The application shall include a detailed analysis of the impacts on Surface Water and, where applicable, Ground water quality of any proposed Structure, Use or Activity which would be allowed if the variance is granted. An evaluation of the potential impact of such proposed Structure, Use or Activity on water quality by reference to the Department's Surface Water Quality Standards for Class A Surface Waters and Outstanding Resource Waters of the Commonwealth, set forth in 314 CMR 4.00 et seq., and/or where applicable, the Massachusetts Ground Water Quality Standards, set forth in 314 CMR 6.00 et seq. shall be provided. The application shall include the water quality data and results to support each analysis and shall provide a detailed description of any methodology employed in performing such analysis to show that water quality will not be impaired by the Structure, Use and Activity for which the variance is being requested, whether during construction or upon continued use or operation of such Structure, Use or Activity.

5. *Mitigating Measures*. The application shall include an analysis of any mitigating measures which will be used which would enable the Division to grant a variance without substantial detriment to the public good and without impairing the quality of water in the Watersheds.

(e) *Additional Materials*. All surveys and additional materials or studies required to act on an application for variance, whether or not requested by the Division, shall be prepared and delivered at the sole cost of the Person submitting the application.

(f) *Public Hearing*. Within 30 days of the Date of Submission of the application for variance with the Division, the Division shall hold a public hearing. Notice of the time and place of the public hearing shall be given by the Division, at the expense

of the Person who submitted the application, not less than five days prior to such hearing by publication in a newspaper of general circulation in the city or town where the property in question is located and by mailing a copy of such notice to the Person who submitted the application at the address specified in the application, and to the Building Inspector, Conservation Commission, and Board of Health in such city or town. At the request of the Person who submitted the application filed with the Division at least two days before the date of such hearing, the date of the hearing may be rescheduled to a time which is mutually convenient for such Person and the Division, provided that such rescheduled time shall permit re-publication of notice as provided herein. The public hearing may be continued, with the consent of the Person who submitted the application, to an agreed upon date, which shall be announced at the hearing. At the public hearing, such Person may be represented by counsel and/or professional consultants and may present oral or written evidence and oral or written testimony of witnesses.

(g) *Variance Decision.* Within 30 days of the close of the public hearing, the Division shall issue a written Variance Decision on the application for variance. If the variance is granted, the Division may impose in the Variance Decision such reasonable conditions, safeguards and limitations as it may find desirable in its sole discretion, which, based on the application for variance and the evidence presented at the public hearing, are necessary to protect the water in the Watersheds. If a variance is denied, the Variance Decision shall contain a brief statement of the reasons for the denial. The granting of a variance is limited to the provisions of St. 1992 c. 36. All other applicable laws, regulations and ordinances shall not be affected by the granting of a variance.

(h) *Recording of Variance Decision.* No variance granted hereunder shall take effect until a Variance Decision (See 350 CMR 11.13) shall have been recorded and indexed in the grantor index in the registry of deeds or registered in the registry district of the land court for the county or district where the property is located, containing any conditions applicable thereto and describing the land by metes and bounds or by reference to a recorded or registered plan showing the property's boundaries.

(i) *Appeal.* A Person to whom a Variance Decision is issued, who seeks to appeal the Division's Variance Decision, shall file a Notice of Claim for an Adjudicatory Proceeding with the Commission at the address specified in 350 CMR 11.11 within 21 days from the Date of Issuance of the Variance Decision by the Division. The procedures for appeal before the Commission shall be as set forth in 801 CMR 1.00 et seq. At the time of filing of such Notice of Claim, a copy shall also be filed with the Division.

(4) Exemption of a Tributary

(a) *Exemption of a Tributary.* The Division, in consultation with the Department, may exempt a Tributary, or portions thereof, upon a determination that such exemption will pose no significant risk to the quality of water, after taking into account the following factors:

1. **rate of flow;**

2. **slope;**

3. soil characteristics;

4. proximity to a Reservoir or the Ware River above the Ware River intake;

5. the current level of water quality; and

6. the current degree of development.

(b) *Presumptions and Standards for Required Findings.*

1. The standard of no significant risk to the quality of water refers to:
   a. the risk of water quality impairment presented by Structures, Uses and Activities which are permissible under all other relevant state, federal and local laws, but would not be permissible under 350 CMR 11.00 without an exemption; and
   b. the cumulative risk of water quality impairment from all Structures, Uses and Activities allowed under current regulations over time.

2. There shall be a presumption that exempting a Tributary or portion thereof is contrary to the achievement of the purpose of St. 1992 c. 36. The presumption may be rebutted only by the submission of credible evidence by the Person submitting the request for Exemption to establish that such exemption will pose no significant risk to the quality of water, taking into account the factors enumerated at 350 CMR 11.06(4)(a).

(c) *Requests for Exemption.*

1. A request for Exemption of a Tributary may be made by:
   a. An affected landowner;
   b. Any state agency or regional planning commission;
   c. The Board of Selectmen, City Council, Mayor, Planning Board or Conservation Commission of any city or town which would be affected by the exemption; or
   d. The Governor or any member of the General Court.

2. A request for Exemption of a Tributary shall be made to the Division (See 350 CMR 11.13) by filing the same by certified mail or hand delivery with the Division at the address specified in 350 CMR 11.11. A copy of the request for Exemption of a Tributary shall be sent to the Department at the address specified in 350 CMR 11.11.

(d) *Detailed Statement.* The request for Exemption of a Tributary shall include detailed information regarding each specifically enumerated factor listed in 350 CMR 11.06(4)(a)1. through 6. Such detailed information shall be provided based on conditions existing as of the time of the request and based on conditions which would, or may, result if such exemption were granted and if development occurred to the maximum extent and type allowed by current law. Detailed information on each factor shall be provided as follows:

1. *Flow Rate.* The request shall include the flow rate of the Tributary stated as the annual average daily stream flow, reported as cubic feet per second ("cfs") as measured at the downstream point of discharge for the Tributary

or portion thereof, taking into account the entire contributing drainage area. Such flow rate may be based on field data collected in accordance with accepted stream flow measurement methods as established by the United States Geologic Survey, or estimated based on procedures established by the United States Geologic Survey. The request shall describe, in depth, the basis and method employed for the reported flow rate to assess full build-out scenarios.

2. *Slope.* The request shall state the average slope at the Tributary measured as the change in elevation divided by the distance in stream miles from its source to the downstream point of discharge. The ground slope of all lands adjacent to the Tributary within the areas that would be subject to St. 1992 c. 36 if the exemption were not granted shall be calculated and the results of such calculations shall be presented graphically on a map prepared at a scale of 1"=100' or larger, expressed as percent slope.

3. *Soil Characteristics.* A map prepared at a minimum scale of 1"=100' shall be submitted indicating the soil types as mapped by the SCS. Site specific soils data supporting or contradicting the SCS soil mapping including borings, test pits and percolation tests may be submitted including copies of all field logs, notes, observations, conclusions and test methods employed. A detailed analysis of the soil characteristics of erodibility and permeability shall be provided. Permeability should be described in terms of a percolation rate measured as minutes per inch as specified in Title 5 (310 CMR 15.00).

4. *Proximity to a Reservoir* or *the Ware River above the Ware River Watershed.* Proximity of the Tributary proposed to be exempted to a Reservoir or the Ware River above the Ware River intake shall be indicated by reference to the Protection Zone, defined by the Department's Division of Water Supply, Watershed Resource Protection Plan Policy as Zone A, Zone B and Zone C. The measured distance in stream miles from the downstream discharge point of the Tributary or portion thereof in question from that Tributary's ultimate point of confluence with a Reservoir or stream miles above the Ware River intake shall be stated.

5. *Water Quality.* The request shall include water quality monitoring data for the Tributary consisting of, at a minimum, monthly samples for a continuous one year period at a sampling station located at or near the downstream point of discharge of the Tributary or portion thereof for which exemption is requested. Water quality data of the Division and the Department may be utilized in satisfaction of this requirement where such data is available. Minimum analysis shall include fecal coliform bacteria, color, turbidity, temperature, pH, dissolved oxygen, total suspended solids, total phosphorus, ammonia nitrogen and chloride. A detailed analysis of the water quality data with reference to the Department's Surface Water Quality Standards for Class A Surface Waters and Outstanding Resource Waters of the Commonwealth, 314 CMR 4.00 et seq., shall be provided. The request shall include a detailed analysis of the impact on water quality of

any potential Structures, Uses or Activities allowed if the exemption is granted.

6. *Development.* A general plan showing existing land use within the contributing drainage area upstream at the point of discharge of the Tributary or portion thereof shall be provided. The request shall include a calculation of the percent imperviousness of the contributing drainage area based on the existing land uses shown and shall indicate the change of percent imperviousness which may result from any Structures, Uses or Activities allowed or proposed if the exemption is granted.

7. *Other Information.* The request shall include a detailed description of the Structures, Uses and Activities which are or may be proposed to occur within those areas which would be subject to St. 1992 c. 36 without the exemption and shall include an analysis of any mitigating measures which will be used which would ensure that granting the exemption would present no substantial risk to the quality of water.

(e) *Additional Materials.* All surveys and additional materials or studies required to act on a request for Exemption of a Tributary, whether or not requested by the Division, shall be prepared and delivered at the sole cost of the Person submitting the request.

(f) *Public Hearing.* Within 30 days of the Date of Submission of the request for Exemption of a Tributary with the Division and the Department, the Division and the Department shall hold a public hearing. Notice of the time and place of the public hearing shall be given by the Division, at the expense of the Person who submitted the request, not less than five days prior to such hearing by publication in a newspaper of general circulation in the city or town where the property in question is located and by mailing a copy of such notice to the Person who submitted the request at the address specified in the request, and to the Building Inspector, Conservation Commission and Board of Health in such city or town. At the request of the Person who submitted the request filed with the Division at least two days before the date of such hearing, the date of the hearing may be rescheduled to a time which is mutually convenient for such Person, the Division and the Department, provided that such rescheduled time shall permit re-publication of notice as provided herein. The public hearing may be continued, with the consent of the Person who submitted the request, to an agreed upon date, which shall be announced at the hearing. At the public hearing, such Person may be represented by counsel and/or professional consultants and may present oral or written evidence and oral or written testimony of witnesses.

(g) *Exemption Decision.* Within 60 days of the close of the public hearing, the Division shall issue a written Exemption Decision on the request for Exemption of a Tributary. If the exemption is granted, the Division may impose in the Exemption Decision such reasonable conditions, safeguards and limitations as it may find desirable in its sole discretion, which, based on the request for Exemption of a Tributary and the evidence presented at the public hearing, are necessary to protect the water in the Watersheds. If the exemption is denied, the Exemption Decision shall contain a brief statement of the reasons for the denial. The granting of an exemption is limited to the applicability of St. 1992 c. 36. All other applicable laws, regulations and ordinances shall not be affected by the granting of an exemption.

(h) *Notice of Exemption.* Notice of the Exemption Decision shall be mailed to the Person who submitted the request, and to the City Council or Board of Selectmen in the city or town where the Tributary is located. Notice shall also be published once in a newspaper of general circulation in such city or town, provided, however, that a failure to publish shall not affect the validity of the Exemption Decision. A record of the Exemption Decision shall be kept on file with the Division and, if a Tributary or portion thereof is exempted, the affected area shall be shown on the most recent edition of the Massachusetts Geographic Information System Map (See 350 CMR 11.07).

(i) *Appeal.* A Person to whom an Exemption Decision is issued, who seeks to appeal the Division's Exemption Decision, shall file a Notice of Claim for an Adjudicatory Proceeding with the Commission at the address specified in 350 CMR 11.11 within 21 days from the Date of Issuance of the Exemption Decision by the Division. The procedures for appeal before the Commission shall be as set forth in 801 CMR 1.00 et seq. At the time of filing of such Notice of Claim, a copy shall also be filed with the Division.

(5) Work Pending Appeal of Applicability Decision, Variance Decision or Exemption Decision - No Alterations shall be made or Structures, Uses or Activities commenced until a final administrative or judicial determination has been made and all appeal periods shall have expired if the Division issues:

(a) an Applicability Decision that the property is located in an area regulated by St. 1992 c. 36, that the Structures, Uses or Activities proposed are prohibited by St. 1992 c. 36 under 350 CMR 11.04(3), or that the Structures, Uses or Activities will impair or materially impair the quality of water in the Watersheds; or

(b) a Variance Decision denying the variance requested in an application for variance; or

(c) an Exemption Decision denying a request for Exemption of a Tributary.

11.07: Maps

(1) *Aquifers*. The location and potential well yield of Aquifers shall be determined by reference to the most recent edition of maps generated by the Massachusetts Geographic Information System based on the United States Geological Survey Water Resource Atlases.

(2) *Flood plains*. The location of Flood plains shall be made by reference to the most recent edition of the Flood Hazard Boundary Maps issued by the Federal Emergency Management Agency.

(3) *Surface Waters and Tributaries*. The location of Surface Waters and Tributaries shall be determined by reference to the most recent edition of maps generated by the Massachusetts Geographic Information System based on the United States Geological Survey, 1 to 25,000 scale quadrangle maps.

(4) *Adoption of More Accurate Maps*. With respect to any of the maps referred to in 350 CMR 11.07, the Division, in consultation with the Department, may adopt more accurate maps pursuant to notice and a public hearing as provided by M.G.L. c. 30A. The Division shall file any of such maps which are adopted with the Clerk of the House of Representatives and Clerk of the Senate and such maps shall not take effect until 90 days have elapsed from the time of said filing. Copies of maps which have taken effect shall be filed with the Chief Executive Officers of all cities and towns within the Watersheds, provided that the Division's failure to do so shall not invalidate the maps or any actions taken by the Division in connection therewith.

11.08: Relationship of Act with other State and Municipal Statutes, Ordinances and Regulations

350 CMR 11.00 is intended solely for use in administering St. 1992 c. 36; nothing contained herein should be construed as preempting or precluding more stringent protection of the areas regulated by St. 1992 c. 36 by other statutes, ordinances, by-laws or regulations. The duties and obligations imposed by St. 1992 c. 36 shall be in addition to all other duties and obligations imposed by any general or special law or regulation or any by-law, ordinance or regulation lawfully adopted pursuant thereto.

11.09: General Rules and Regulations for the Protection of Watersheds and the Watershed System

In order to facilitate review of all regulations promulgated by the Commission and the Division relating to Watersheds and the Watershed System, this Section includes regulations of general applicability to Waters of the Watershed System. The regulations in 350 CMR 11.09 are intended to supersede the regulations in 310 CMR 23.00, 350 CMR 8.01, 350 CMR 9.00, and 350 CMR 10.00.

(1) *Waters of the Watershed System*.

(a) No Person shall take or divert any Waters of the Watershed System of the Commission and no Person shall corrupt, render impure, waste or improperly use any such water.

(b) No Person shall:

1. engage in any construction activity involving filling, dredging, grubbing or altering land without adequate provisions to prevent erosion resulting in clay, silt or other turbidity laden waters from entering the Waters of the Watershed System;

2. construct, establish or maintain any agricultural facility or place where animal manure may be deposited or accumulated without adequate provision to prevent any manure or other Pollutant from flowing or being washed into the Waters of the Watershed System;

3. engage in any other activity which could degrade the quality of Waters of the Watershed System or interfere with their use as a source of water supply.

(c) No Person shall allow a condition to exist on such Person's property which could result in the direct or ultimate discharge of any Pollutant into the Waters of the Watershed System.

(d) Any records of any board of health or health agent concerning matters within the Watershed shall be open to inspection by the employees and agents of the Commission and the Department.

(e) Whenever an incident occurs, is likely to occur, or a situation exists that threatens to add Pollutants to the Waters of the Watershed System, the Person causing or contributing to the pollution or potential pollution shall notify the Commission and the Department immediately.

(2) Watershed System.

(a) *General Regulations*.

1. Entrance on and exit from land of the Watershed System shall be made through gates or other designated areas.

2. No Person is allowed within any land of the Watershed System, except from one hour before sunrise to one hour after sunset, unless authorized by a written permit from the Commission or its designee.

3. Powered boats are prohibited within the Waters of the Watershed System except in areas designated by the Commission or its designee.

4. All acts which pollute or may pollute the water supply are prohibited. No litter or refuse of any sort may be thrown or left in or on any land or water within any Watershed System. All Persons within said System shall use the sanitary facilities provided for public use.

5. All acts which injure the property of the Commonwealth are prohibited. No Person shall injure, deface, destroy, remove or carry off any property, real or personal, under the care and control of the Commission, including but not limited to, all historic artifacts and natural materials. The removal of gravel, topsoil, stones, boulders, or other earthen material is prohibited from the Watershed System except for removal for official use for land management purposes by Commission staff. No Person shall build or construct any object or structure of the property of the Commonwealth except with the written permission of the Commission or its designee.

6. Cooking and all fires are prohibited within the Watershed System.

7. No Person shall wade or swim in any reservoir except wading while using boots for the purpose of launching boats at designated boat launch areas.

8. No Person shall wade or swim in any Tributary or Surface Waters on or within the property of the Commonwealth except at areas designated by the Commission or its designee.

9. Organized sports activities, including but not limited to orienteering and baseball, are prohibited in the Watershed System except by written permit from the Commission or its designee.

10. Any violation of 350 CMR 11.09 will be deemed sufficient cause for revocation of fishing privileges for a period of time not less than one year from the time of violation. The Commission and its employees are not responsible for any damage to or loss of property sustained by fishermen, or for any injury or loss of life which may be incurred in connection with public use of the reservoirs and Watershed System.

11. Breach of peace, profanity or other disorderly conduct offensive to the general public is strictly prohibited within the Watershed system. Possession of and drinking of alcoholic beverages is prohibited within said System.

12. No Person shall drive a motorized vehicle within the Watershed System except upon roads authorized for such use by the Commission or its designee. Recreational vehicles are prohibited on all Watershed System property except the use of snowmobiles in areas designated by the Commission or its designee. Motor vehicles shall be parked only in areas designated by the Commission or its designee. Operators of motor vehicles shall obey all regulatory signs unless otherwise directed by a police officer or person in charge. No Person shall willfully obstruct the free passage of vehicles or Persons within the Watershed System. Vehicle access for official use may be granted by the Commission or its designee.

13. No Person shall bring any animal within any Watershed System property except for horses and dogs at the Ware River Watershed at areas designated by the Commission or its designee.

14. The use of bicycles, skis and other means of non-motorized transportation within the Watershed system shall be permitted only in areas designated by the Commission or its designee.

15. No Person, except in an emergency, shall bring, land or cause to descend within any Watershed System property any aircraft except with a written permit from the Commission or its designee.

16. Parades, games, fairs, carnivals, fishing derbies, bazaars, gifts or solicitations for raising or collecting funds shall not be permitted within the Watershed System without written approval of the Commission or its designee.

17. Lotteries, raffles, gambling and games of chance are prohibited; and no Person shall have possession of machinery, instruments or equipment of any kind for use of same in the Watershed System.

18. Public assemblies of more than 25 persons shall not be allowed within the Watershed System without a written permit from the Commission or its designee.

19. No Person shall engage in any business, sale or display of goods or wares within the Watershed System without a written permit from the Commission or its designee.

20. Commercial signs and advertising are prohibited in the Watershed System.

21. No Person shall have possession of or discharge any weapon, firearm, fireworks, or other explosive on or within the Watershed System except at times and areas designated by the Commission or its designee. All forms of target shooting are prohibited on or within the Watershed System.

22. No Person may hunt, shoot or trap animals on or within any Watershed System property except at times and in areas designated by the Commission or its designee.

23. All Persons within the Watershed System shall obey the lawful directions of regulatory signs, police officers or persons in charge, or of Federal or Commonwealth wardens or enforcement officers.

24. The Watershed System or parts thereof may be closed for public access at the discretion of the Commission or its designee when necessary to protect the lands and waters under the care and control of the Commission.

25. The possession of all types of metal detectors or similar devices is prohibited on all of the Watershed System property.

(b) *Special Regulations for Quabbin Reservoir*.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations, will be allowed to fish from shore in areas designated by the Commission or its designee. A valid state fishing or sporting license is required by any Person renting or launching a boat at any Commission facilities subject to 350 CMR 11.09. Reasonable fees for the use of boats, for rental of outboard motors for fishing purposes, or use of Commission facilities including parking and boat ramps, may be charged by the Commission.

2. Persons permitted to fish from boats shall, at all times, be responsible for the sanitary condition of the boats. Persons under 16 years of age must be accompanied by a Person possessing a valid fishing license in order to boat on Quabbin Reservoir.

3. Only boats of a minimum length of 12 feet, and of a type considered safe by the Commission representative in charge, shall be used. No inboard motors, collapsible boats, sailboats, pontoon boats, square sterned canoes, or other similar craft will be permitted in the water, and no boats will be permitted in the water except in areas designated for boating by the Commission or its designee. Outboard motors shall have a rating of not

more than one-half the BIA or OBC rated horsepower for the boat and shall not exceed 20 horsepower, except that outboard motors for Commission boats less than fourteen 14 feet six inches in length shall not exceed ten horsepower. Boats less than 14 feet six inches in length will be limited to three occupants, and boats of that length and in excess thereof may be licensed to carry four occupants. No boats shall carry more than four occupants. Canoes and jon boats of a minimum length of 12 feet, and of a type considered safe by the Commission representative in charge, shall be used and only in areas designated for boating by the Commission on Pottapaug Pond above the regulating dam and at Gate 31 above the regulating dam. Canoes less than 16 feet and jon boats less than 14 feet six inches in length will be limited to two occupants, and canoes and jon boats in excess thereof may be licensed to carry three occupants. All boats must be in compliance with current Commonwealth Boating Laws. All boats must be clean and contain no refuse of any kind. Commission personnel shall have the right to inspect all private boats launched at Commonwealth facilities and may deny access in order to protect water quality or the safety of occupants. Chock blocks must be used on vehicles when removing boats from the Reservoir.

4. No Person shall operate a motor boat at a speed other than reasonable and proper or in such a manner as to annoy or endanger the occupants of other boats.

5. Fishing from the shorelines of the Quabbin Reservoir and its Tributaries within the Watershed System or from boats shall be allowed only during a season designated by the Commission or its designee. All privately-owned boats, motors and other equipment must be removed from the property of the Commission each day.

6. Boats shall not leave the mooring areas before dawn, and must return at the time posted at each mooring area. The beaching of boats at any point except at the designated mooring and landing areas is strictly prohibited, except in cases of extreme emergency.

(c) *Special Regulations for Ware River*.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations will be allowed to fish in the Ware River in areas designated by the Commission or its designee.

2. Powered boats and powered canoes are prohibited within the Ware River Watershed Reservation.

(d) *Special Regulations for Wachusett Reservoir*.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations will be allowed to fish from the shore of Wachusett Reservoir in areas designated by the Commission or its designee.

2. Boating is prohibited in Wachusett Reservoir.

3. Fishing from the shoreline of the Reservoir shall be allowed only during a season designated by the Commission or its designee.

(e) ***Special Regulations for Sudbury Reservoir***.

1. Persons in compliance with Commonwealth Fish and Game Laws and Regulations will be allowed to fish from the shore of Sudbury Reservoir in areas designated by the Commission or its designee.

2. Boating is prohibited on Sudbury Reservoir except in areas designated by the Commission or its designee.

11.10: Enforcement

Any Person who, without lawful authority, takes or diverts any Waters of the Watershed System or corrupts or defiles any such Waters or any source of such Waters or who violates and refuses to comply with any rule, regulation or order of the Commission shall be subject to the fines set forth in M.G.L. c. 92, § 111. The provisions of 350 CMR 11.00 shall be enforced upon petition of the Commission or of any town or Person interested by the Supreme Judicial Court or Superior Court or any justice of either court as provided in M.G.L. c. 92, § 112. In addition, upon written request by the Division, the Department shall have the authority to enforce the provisions of St. 1992 c. 36 and 350 CMR 11.00 by all legally permitted enforcement mechanisms including, but not limited to: issuing notices of noncompliance; convening pre-enforcement conferences; issuing water supply orders pursuant to M.G.L. c. 111, § 160; and imposing administrative penalties pursuant to M.G.L. c. 21A, § 16 and 310 CMR 5.00. Such written request by the Division to the Department may seek enforcement for a specified type of violation or area, for a designated group of cases or for an individual matter.

11.11: Miscellaneous

(1) Addresses - Offices of Division

**Metropolitan District Commission
Quabbin Reservoir
485 Ware Road
Belchertown, Massachusetts 01007**

**Metropolitan District Commission
Wachusett Reservoir
P.O. Box 206
Clinton, Massachusetts 01510**

(2) Address of Commission -

**Metropolitan District Commission
First Floor
20 Somerset Street
Boston, Massachusetts 02108**

(3) Address of Department -

**Department of Environmental Protection
Commonwealth of Massachusetts
Regional Division
One Winter Street
Boston, Massachusetts 02108**

(4) Access to Property by Division - Any Person making a request for Watershed determination of applicability, an application for variance or a request for Exemption to the Division shall, upon request, allow the Division or its duly authorized representatives to inspect the property in question in order to assist the Division in the determination which is to be made. Personnel of the Division may enter, at reasonable times, any property, public or private, for the purpose of investigating or inspecting any condition relating to the discharge or possible discharge of Pollutants into the Watershed System and may make such tests as may be necessary to determine the existence and nature of such discharge as provided in M.G.L. c. 21, § 4.

11.12: Severability

If any provision or any part of 350 CMR 11.00 or the application thereof is held to be invalid, such invalidity shall not affect any other provision of 350 CMR 11.00.

11.13: Forms

Forms for use under the Watershed Protection Act shall be as follows:

Form 1 - Request for Watershed Determination of Applicability

Form 2 - Applicability Decision

Form 3 - Application for Variance

Form 4 - Variance Decision for Recording in Registry of Deeds

Form 5 - Request for Exemption of a Tributary

Forms 1, 3 and 5 and a Guidance Document, which may be of assistance in completing the forms, may be obtained from the Division at the addresses specified in 350 CMR 11.11(1) and (2).

Appendix C
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Coverage of WsPA

WsPA is different from many other environmental regulations because it ties jurisdiction to computerized mapping information gathered from a number of different sources: reservoirs, tributaries, and surface waters are identified from United States Geological Survey topographic surveys, and floodplains from Federal Emergency Management Agency maps, for instance.

USGS map (portion).

With this information and assessors' maps, owners of affected parcels were identified (to the extent possible) and notified in November 1994 that WsPA affects their land. Information of varying accuracy was used, and some parcels were not identified, including:

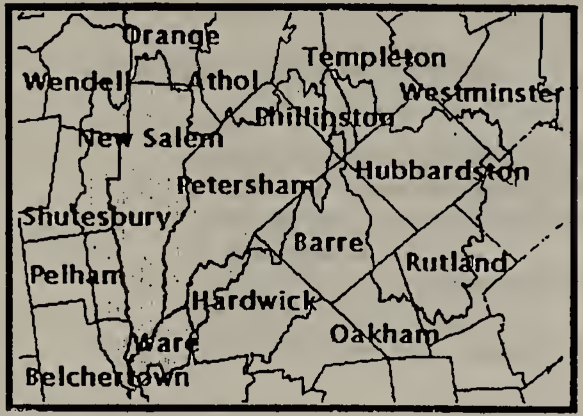
- **Newly subdivided parcels;**
- **Parcels with bordering vegetated wetlands (determined by Conservation Commission and DEP);**
- **Some parcels adjacent to surface waters; and**
- **Some parcels owned by towns or conservation organizations.**

We continue to try to make this information as accurate as possible. **Please contact DWM if you are aware of errors.**

For Further Information

- **Massachusetts General Laws ch. 92, sec. 107A**
- **350 Code of Mass. Regs 11.00**
- **Guidance Document for Making Applications under the Watershed Protection Act**
- **MDC web site:** www.state.ma.us/mdc/water.htm

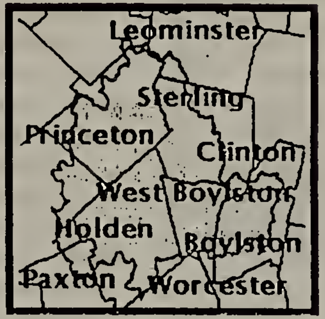
Regarding property in one of these Quabbin Reservoir and Ware River Watershed Communities----


Orange
Wendell
Athol
Templeton
Westminster
New Salem
Phillipston
Petersham
Hubbardston
Shutesbury
Barre
Rutland
Pelham
Hardwick
Oakham
Ware
Belchertown

Write or call:

Quabbin Planning Office
Belchertown Rd.
Belchertown, MA 01007
(413) 323-6921, x501

Regarding property in one of these Wachusett Reservoir watershed communities----

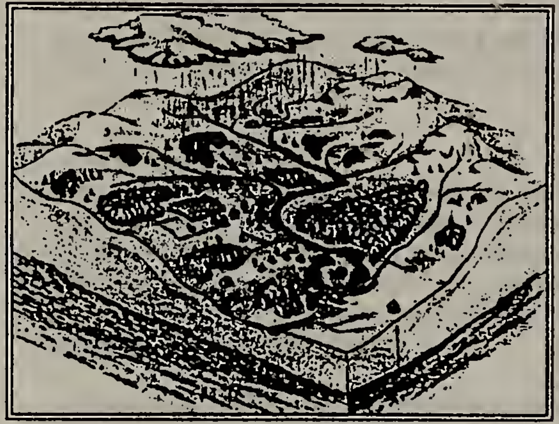

Leominster
Sterling
Princeton
Clinton
West Boylston
Holden
Boylston
Paxton
Worcester

Write or call:

Wachusett Planning Office
P.O. Box 206
Clinton, MA 01510
(508) 792-7423, x314

Cover art: Jim Taylor
Map samples: MassGIS
Text and layout: Jeanne Wildman.
review by WsPA Working Group.
Revised December 1999.

The Massachusetts Watershed Protection Act



Watershed regulations for land in Quabbin Reservoir, Ware River and Wachusett Reservoir watersheds

MDC

Commonwealth of Massachusetts
Metropolitan District Commission
Argeo Paul Cellucci, Governor
Jane Swift, Lt. Governor
Bob Durand, Secretary, EOEA
David B. Balfour, Jr., MDC Commissioner

The Watershed Protection Act

The Watershed Protection Act (WsPA) regulates land use and activities within critical areas of the Quabbin Reservoir, Ware River and Wachusett Reservoir watersheds for the purpose of protecting the quality of drinking water. Administered by the Division of Watershed Management (DWM) of the Metropolitan District Commission, WsPA applies only in towns in MDC watersheds. **See the back of this brochure for names of towns affected by WsPA and references to the full text of the act and its regulations.**

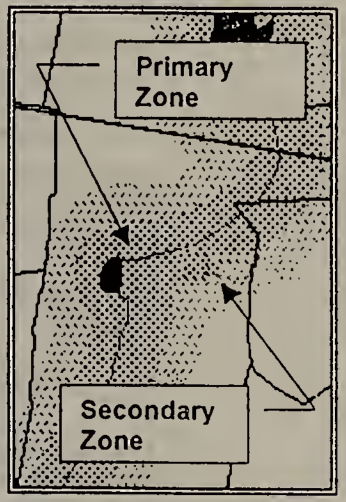
Why Regulate Land Use?

Many aspects of the use and development of land affect the quality of nearby streams, which then flow into reservoirs and other sources of water supply. Type of development, density, amount of paved surface, and proximity to a stream contribute to the amount and types of pollutants in the stream. Often it is desirable to preserve a buffer zone beside open water, or limit impervious surface over an aquifer; but physical conditions on the land may allow for different rules in different settings.

Protected Zones and Restrictions

Two areas are protected in different ways under the WsPA.

Within 400 feet of the reservoirs and 200 feet of tributaries and surface waters (the "Primary Zone"), **any alteration is prohibited.** "Alteration" includes a variety of activities, such as construction, excavation, grading, paving, and dumping. Generation, storage, disposal or discharge of pollutants is also prohibited in the Primary Zone.



Between 200 and 400 feet of tributaries and surface waters, and on land within flood plains, over some aquifers, and within bordering vegetated wetlands (the "Secondary Zone"), certain activities are specifically prohibited. These include storage, disposal or use of toxic, hazardous, and certain other materials; alteration of bordering vegetated wetlands; more dense development; and other activities. See 350 CMR 11.04 for a complete list.

Exemptions

There are a number of exemptions to the restrictions under WsPA. The most common are:

- **Uses, structures and facilities lawfully existing as of July 1, 1992;**
- **Construction of a single-family dwelling on an existing vacant lot;**
- **Minor changes to an existing structure;**
- **Division of an owner-occupied existing parcels to create one additional building lot.**

See 350 CMR 11.05 for a complete list.

Many exemptions are subject to qualifications. For instance, an expansion is exempt only if it does not degrade water quality. For anything other than an existing activity, therefore, contact DWM (numbers are given on the back of this brochure) and make an application even if the activity may be exempt.

Types of WsPA Applications

Advisory Ruling
This type of application gives an informal indication of whether WsPA applies to the proposed activity. To apply for an Advisory Ruling, send a letter to one of the addresses on the back of this brochure and include:

- **Description of work proposed;**
- **Copy of the assessor's map (or sheet and parcel number);**
- **Copy of the deed showing ownership;**
- **Copy of plans or surveys, if available; and**
- **Other relevant information.**

Send the letter requesting an Advisory Ruling to the address shown on the back. An advisory ruling usually takes a few days to a few weeks, unless the project is complicated and warrants further review.

Determination of Applicability
This application is to determine whether WsPA applies to the proposed activity, or if the activity might be exempt or otherwise not prohibited. It yields a formal determination, with a 60-day time limit for an answer, which may be recorded at the local Registry of Deeds.

Variance
Apply for a Variance if WsPA does apply but it can be demonstrated that the proposed activity will not impair water quality.

Exemption of a Tributary
Apply for this exemption if WsPA applies, but a tributary or portion of one can be exempted with no significant risk to water quality.

Except for Advisory Rulings, the applications require specific forms. For forms, full text of the regulations, and further information, see the back of this brochure.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION

In the Matter of

The Massachusetts Water
Resources Authority

CONSENT ORDER
ACO-BO-91-5001

I. PARTIES

1. The Department of Environmental Protection is a duly constituted agency of the Commonwealth of Massachusetts having its principal office located at One Winter Street, Boston, Massachusetts 02108. The Department has primary responsibility to enforce the requirements of the federal Safe Drinking Water Act, 42 U. S. C. §§ 300f et seq. (the "Act"), and regulations promulgated thereunder by the United States Environmental Protection Agency ("USEPA"). The Department has authority to adopt regulations and issue orders to ensure the delivery of safe drinking water by public water systems to consumers. M. G. L. c. 111, §§ 5G and 160.

2. The Massachusetts Water Resources Authority is a body politic and corporate and a public instrumentality established pursuant to the Massachusetts Water Resources Authority Act of 1984, Chapter 372 of the Massachusetts Acts and Resolves of 1984, having its principal place of business located at the Charlestown Navy Yard, 100 First Avenue, Charlestown, Massachusetts 02129.

II. FACTS AND LAW

3. On June 29, 1989, the USEPA promulgated National Primary Drinking Water Regulations for Giardia lamblia, viruses, heterotrophic plate count bacteria, Legionella and turbidity, codified at 40 C. F. R. §§ 141.70 et seq. The Department has promulgated regulations at 310 C. M. R. 22.20A which implement the Surface Water Treatment Rule ("SWTR"). The SWTR establishes treatment technique requirements that apply to all public water systems using surface water or ground water sources under the direct influence of surface water.

4. The SWTR requires public water suppliers to install and properly operate treatment processes which reliably achieve the following:

   (a) at least 99.9 percent removal and/or inactivation of Giardia lamblia cysts between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream or at the first customer; and

   (b) at least 99.99 percent removal and/or inactivation of viruses between a point where the raw water is not subject to recontamination by surface water runoff and a point downstream or at the first customer.

5. Under the SWTR, a public water supplier is considered to be in compliance if:

   (a) the public water system meets the source water quality criteria and site specific criteria in 310 C. M. R. 22.20A(2), and the disinfection requirements of 310 C. M. R. 22.20A(3)(a); or

   (b) the public water system meets the filtration requirements set forth in 310 C. M. R. 22.20A(4) and the disinfection requirements in 310 C. M. R. 22.20A(b).

6. The Massachusetts Drinking Water Regulations prohibit open distribution reservoirs unless the following requirements are met:

   (a) a free chlorine residual of at least 0.25 milligrams per liter after ten minutes of contact time is maintained at all times in water leaving the reservoir;

   (b) the water leaving the reservoir meets the requirements set forth in 310 C. M. R. 22.05 for coliform bacteria and 310 C. M. R. 22.08 for turbidity; and

   (c) the department has approved the public water supplier's schedule for covering the reservoir.

   310 C. M. R. 22.19 (3).

7. The MWRA operates a waterworks system which supplies source water to the City of Chicopee, the Town of Wilbraham and the South Hadley Fire District No. 1 (collectively referred to herein as the Chicopee Valley Aqueduct communities or "CVA" communities). Each CVA community operates a waterworks system which regularly provides piped water for human

consumption at least sixty days out of the year through at least fifteen service connections. The systems operated by the MWRA and each CVA community are thus public water systems (PWS) within the meaning of the Massachusetts Drinking Water Regulations, 310 C. M. R. 22.00, and are required to comply with the SWTR.

8. The MWRA waterworks system serving the CVA communities obtains water from the Quabbin Reservoir, which is an unfiltered source.

9. The MWRA waterworks system serving the CVA communities includes Nash Hill Reservoir, which is an open distribution reservoir.

10. The Metropolitan District Commission ("MDC") operates and maintains the watershed system held by or on behalf of the Commonwealth used primarily to supply water to the MWRA waterworks system, which watershed system includes Quabbin watershed, Quabbin Reservoir, and Ware River watershed.

11. In May, 1990, the MWRA began to perform source water quality monitoring at locations approved by the Department and has submitted monthly data to the Department.

12. On July 24, 1990, the MWRA initiated a Pilot Treatment Program under which the MWRA is developing the scientific and engineering data necessary to assess alternatives for disinfection and corrosion control treatment of Quabbin water and to gather information and identify types and concentrations of disinfection by-products that are likely to form in the MWRA's treated water when it is treated with various disinfectants. Pilot testing for disinfection and corrosion control is anticipated to end in September, 1992.

13. On March 14, 1991, the MWRA and MDC submitted to the Department a Watershed Resource Protection Plan for the Quabbin and Ware River watersheds ("Quabbin Plan"), prepared in accordance with the Department's Policy No. 89-90, entitled "Watershed Resource Protection Plan Policy" and the Department's guidance document entitled "Guidance on the Preparation of a Watershed Resource Protection Plan ("WRPP"), dated February, 1990.

14. On October 3, 1991, the MWRA submitted to the Department a letter from the Massachusetts Department of Public Health indicating that the Quabbin Reservoir has never been identified at any time as the source of a waterborne disease outbreak.

15. On November 5, 1991, the DEP issued a Preliminary Waiver Determination that the MWRA meets most of the requirements of the criteria for avoiding

filtration for the Quabbin Reservoir. MWRA responded to the Preliminary Waiver Determination on December 4, 1991. DEP will issue a final determination on or before December 31, 1991.

16. Continued compliance with the site specific and source water quality criteria of 40 C. F. R. 141.71 and 310 C. M. R. 22.20A(2) and the conditions of the Department's determination with respect to the Quabbin Reservoir and Quabbin Watershed area will depend in part on the ability of the MWRA in cooperation with other governmental entities, including but not limited to MDC, to implement best management practices, regulatory control measures, land use controls, and other measures, to eliminate or restrict activities detrimental to source water quality.

III. DISPOSITION AND ORDER

17. Because the Department and the MWRA seek to set forth an approved course of action for the MWRA to comply with the conditions set forth by the Department under which the Quabbin Reservoir will continue as an unfiltered source for the CVA communities, and pursuant to the authority granted to the Department by M. G. L. c. 111, §§ 5G and 160, and 310 C. M. R. 22.00, the MWRA consents to and the Department hereby orders the following.

18. The MWRA shall continue to monitor source water quality at Winsor Dam. The MWRA shall continue to monitor source water coliform and turbidity concentrations at the locations approved by the Department in accordance with 310 C. M. R. 22.20A and report the results to the Department before the 10th of each month.

19. The MWRA has submitted plans for the construction of an interim disinfection facility at Winsor Dam to the Department for its approval, and on or before December 31, 1991, the MWRA shall complete construction of such facility to comply with disinfection requirements for unfiltered systems at 310 C. M. R. 22.20A(3)(a), as determined by the Department and in accordance with the August 13, 1991 letter from DEP Western Region to MWRA.

20. On or before January, 1993, the MWRA shall submit to the Department in writing a report of the results of the Pilot Treatment Program and its proposal concerning additional pilot testing deemed necessary or advisable for Quabbin Reservoir in order to determine the best treatment technology to be implemented to achieve compliance with the SWTR without compromising compliance with other requirements under other drinking water regulations, which proposal shall include a schedule for the completion of such additional

pilot testing and for the submission in writing to the Department for review a report of the results of such pilot testing and the MWRA's decision concerning treatment technology.

21. Within 6 months of the approval by the Department of the treatment technology decision submitted by the MWRA, the MWRA shall submit to the Department for its approval and for inclusion in this Consent Order a schedule for the design and construction of the facilities required to implement such treatment technology.

22. The MWRA shall use its best efforts to enter into a Memorandum of Understanding with each CVA community by June 30, 1992 to document the CVA community's request and the MWRA's agreement that MWRA take responsibility to meet state drinking water standards at the meter connection to the CVA community's distribution system.

23. The MWRA shall provide covered storage at Nash Hill Reservoir as follows. On or before December 31, 1992, the MWRA will procure a consultant for the design of covered storage at Nash Hill Reservoir. The MWRA shall require the preliminary evaluation for such project and the filing of an environmental notification form under the Massachusetts Environmental Policy Act and regulations to be completed no later than September 30, 1993. Within three months of the receipt of the decision of the Secretary of Environmental Affairs on the environmental notification form, the MWRA shall submit to the Department for its approval and for inclusion in this Consent Order an approvable schedule for the completion of design and construction of this project.

24. The MWRA shall implement those control measures identified in the Quabbin Plan as the MWRA's responsibility and use its best efforts to gain the cooperation of the other governmental bodies necessary to implement all other identifed control measures. The MWRA shall use its best efforts to enter into a Memorandum of Understanding with the MDC by June 30, 1992 which sets forth the responsibilities of each under the Quabbin Plan.

25. The MWRA shall submit an annual report to the Department, the first such report due on or before January 10, 1993, which will include such information as the Department may require regarding the MWRA's progress toward meeting the requirements of this Consent Order.

26. The MWRA shall contact the Department no later than March 1 of each year to arrange for an annual on-site inspection of the disinfection system operated by the MWRA.

27. In the event the MWRA is unable to agree with one or more of the CVA communities on a Memorandum of Understanding by June 30, 1992, the MWRA may, at its option, notify the Department in writing concerning the impact of such event on the performance of its obligations under this Consent Order, and upon receiving such notice, the Department shall meet with the MWRA to agree on appropriate modifications to this Consent Order.

28. This Consent Order shall be binding upon the MWRA after the effective date hereof and shall be in effect until treatment facilities for the Quabbin Reservoir which fully comply with the Surface Water Treatment Rule have been constructed and are in operation, provided, however, that this Consent Order shall cease to be in effect upon the occurrence of one of the following events:

    (a) the Department determines in writing that any one or more of the criteria for avoiding filtration with regard to Quabbin Reservoir has not been met and that filtration is required.

    (b) the MWRA notifies the Department that the Quabbin Reservoir is no longer used as a source for any of the CVA communities.

29. When notices, reports or other submissions are either required to be submitted or appropriate pursuant to the terms of this Consent Order, such submissions shall be sent by first class mail, telefacsimile, certified mail return receipt requested or hand delivery to:

    If to the Department:

    Director - Division of Water Supply
    Department of Environmental Protection
    One Winter Street, 9th floor
    Boston, Massachusetts 02108

    with a copy to:

    Regional Engineer
    Department of Environmental Protection - Western Office
    436 Dwight Street
    Springfield, MA 01103

If to the MWRA:

Executive Director
Massachusetts Water Resources Authority
Charlestown Navy Yard
100 First Avenue
Charlestown, Massachusetts 02129

with a copy to:

Director, Waterworks Division
Massachusetts Water Resources Authority
Charlestown Navy Yard
100 First Avenue
Charlestown, Massachusetts 02129

30. The MWRA shall require each contractor and subcontractor retained to perform work contemplated herein to perform such work in accordance with the terms and conditions of Department-approved plans.

31. This Consent Order does not relieve the MWRA or any other person of the necessity of complying with all other applicable federal, state and local statutes, regulations, codes, by-laws and ordinances.

32. This Consent Order is not a Notice of Noncompliance and is not issued pursuant to M. G. L. c. 21A, § 16, and 310 C. M. R. 5.00. In the event that the MWRA fails to comply with any provision of this Consent Order, the Department may issue a notice to the MWRA identifying the nature of the failure to comply and specifying a reasonable deadline by which the MWRA either shall come into compliance or submit to the Department a written proposal setting forth how and when the MWRA shall come into compliance. If the MWRA fails to comply with the deadline set forth in the Department's notice, the Department may take other appropriate action, which may include requiring filtration of water from the Quabbin Reservoir. Notwithstanding the foregoing, the Department shall provide the MWRA the opportunity to meet with the Department prior to its decision to take further action in order to consider whether such failure to comply is material to the criteria for avoiding filtration and whether further action by the MWRA to come into compliance with the criteria for avoiding filtration is feasible and achievable; if such failure to comply was not material, the Department shall not require filtration unless and until the MWRA, following such meeting, does not cure such failure to comply within a reasonable time period established by the Department and the Department determines that the failure to cure is a material failure to comply. For

purposes of this Consent Order, the Department will deem material an act or omission which causes the MWRA to fail to meet one or more of the criteria for avoiding filtration.

33. Except as provided in paragraph 32 above, nothing in this Consent Order shall be construed as, or operate as, barring, diminishing, or in any way affecting any legal or equitable right of the Department to issue any future Order with respect to the subject matter covered by this Consent Order, or in any way affecting any other claim, action, suit, cause of action, or demand that the Department may have with respect thereto, if substantially different information is received by the Department after the effective date of this Consent Order which in whole or in part indicates that the work for which this Consent Order provides is not protective of human health or the environment or any change in applicable federal or state law or regulations occurs which imposes new or higher standards.

34. The MWRA shall not be deemed to be in violation of the terms of this order if it is prevented from performing a term or condition of the Order by causes beyond its control and not due to its fault or neglect.

35. If the MWRA is prevented from complying with any provision of this consent order by causes beyond its control and not due to its fault or neglect, the MWRA shall notify the Department in writing within 15 days of the date on which the MWRA first knew of such event. The MWRA shall take all reasonable measures to avoid or minimize any such violation, the time for performance of affected requirements of this Order shall be extended in writing by the Department for the period of any unavoidable delay resulting from such circumstances and no penalties shall be due for noncompliance with this Order during the period of such extension.

36. The provisions of this Consent Order shall apply to and be binding upon the MWRA and its employees, agents and assigns. The MWRA shall not violate this Consent Order, and shall not allow or suffer its employees, agents, or contractors to violate this Consent Order. No body politic, agency or municipality of the Commonwealth shall be deemed to be an employee, agent or contractor of the MWRA for purposes of this Consent Order.

37. Nothing in this Consent Order shall be construed to release any public water supplier from responsibility for installing and properly operating water treatment processes which meet the requirement of the SWTR in the event the MWRA is unable to meet the requirements for avoiding filtration.

38. Nothing in this Consent Order shall be construed to create or affect the rights of persons or entities who are not parties hereto.

39. The effective date of this Consent Order shall be the date of the last signature set forth below.

40. The MWRA's undersigned representative hereby certifies that he or she is fully authorized to enter into the terms and conditions of this consent Order and to execute and legally bind the MWRA to this Consent Order.

MASSACHUSETTS WATER RESOURCES AUTHORITY	DEPARTMENT OF ENVIRONMENTAL PROTECTION
Paul F. Levy	
Typed name	Typed name
Executive Director	
Typed title	Typed title
December 12, 1991	December 27, 1991
Date	Date

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COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL PROTECTION
ONE WINTER STREET, BOSTON, MA 02108 617-292-5500

ARGEO PAUL CELLUCCI
Governor

JANE SWIFT
Lieutenant Governor

BOB DURAND
Secretary

LAUREN A. LISS
Commissioner

November 28, 2000

Joseph M. McGinn, Director
Division of Watershed Management
Metropolitan District Commission
20 Somerset Street
Boston, MA 02108

RE: Comments – Quabbin Reservoir Protection Plan Update, dated October 2000

Dear Mr. ~~McGinn~~ Joe:

DEP's Drinking Water Program (DWP) staff has reviewed MDC's draft Watershed Protection Plan Update, dated October 2000, for Quabbin Reservoir and have the following comments on the document.

1. MDC staff has done an excellent job preparing this updated protection plan in-house. The document clearly describes MDC's pro-active programs to address potential threats within the Quabbin Reservoir watershed.
2. Page 2-67 incorrectly defines DEP's protection zones for Class A public drinking water sources. The correct definitions, found in 310 CMR 22.00, are attached.

Please call me at 617-292-5529 if you have any questions regarding our review of your draft update, or if you would like to arrange to meet with DWP staff during your work to finalize the document.

Sincerely,

David Y. Terry, Program Director
Drinking Water Program

cc: William Pula, MDC DWM
✓Lisa Gustavsen, MDC DWM   Douglas Paine, DEP WERO

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DEP on the World Wide Web: http://www.state.ma.us/dep

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Watershed means the area contained within geomorphic or topographic boundaries of higher elevations which cause surface water and/or groundwater to drain or flow to lower elevations into water used as a public water system source.

Zoning controls means by-laws and ordinances adopted by cities and towns in accordance with M.G.L. c. 40A.

Zone A means
(a) the land area between the surface water source and the upper boundary of the bank;
(b) the land area within a 400 foot lateral distance from the upper boundary of the bank of a Class A surface water source, as defined in 314 CMR 4.05(3)(a); and
(c) the land area within a 200 foot lateral distance from the upper boundary of the bank of a tributary or associated surface water body.

Zone B means the land area within one-half mile of the upper boundary of the bank of a Class A surface water source, as defined in 314 CMR 4.05(3)(a), or edge of watershed, whichever is less. However, Zone B shall always include the land area within a 400 foot lateral distance from the upper boundary of the bank of the Class A surface water source.

Zone C means the land area not designated as Zone A or B within the watershed of a Class A surface water source as defined at 314 CMR 4.05(3)(a).

Zone I means the protective radius required around a public water supply well or wellfield. For public water system wells with approved yields of 100,000 gpd or greater, the protective radius is 400 feet. Tubular wellfields require a 250 foot protective radius. Protective radii for all other public water system wells are determined by the following equation: Zone I radius in feet = (150 x log of pumping rate in gpd) - 350. This equation is equivalent to the chart in the Division's Water Supply Guidelines. A default Zone I radius or a Zone I radius otherwise computed and determined by the Department shall be applied to transient non-community (TNC) and non-transient non-community (NTNC) wells when there is no metered rate of withdrawal or no approved pumping rate. The default Zone I radius shall be 100 feet for TNC wells and 250 feet for NTNC wells.

Zone II means that area of an aquifer which contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at approved yield, with no recharge from precipitation). It is bounded by the groundwater divides which result from pumping the well and by the contact of the aquifer with less permeable materials such as till or bedrock. In some cases, streams or lakes may act as recharge boundaries. In all cases, Zone II shall extend upgradient to its point of intersection with prevailing hydrogeologic boundaries (a groundwater flow divide, a contact with till or bedrock, or a recharge boundary).

Zone III means that land area beyond the area of Zone II from which surface water and groundwater drain into Zone II. The surface drainage area as determined by topography is commonly coincident with the groundwater drainage area and will be used to delineate Zone III. In some locations, where surface and groundwater drainage are not coincident, Zone III shall consist of both the surface drainage and the groundwater drainage areas.

(2) Definitions as Related to Cross Connections. As used in 310 CMR 22.22, unless the context indicates otherwise, the following words shall have the following meanings:

Air Gap Separation means the method of preventing backflow through the use of an unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other device and the flood level rim of the receptacle.

Approved Backflow Prevention Device or Device means a method to prevent backflow approved by the Department for use in Massachusetts